THE REFINER AND NATURAL GASOLINE MANUFACTURER

In This Issue

Who has cracking processes? The list in this issue shows refiners in United States who have turned to cracking.

The history of cracking—C. M. Johnson, chief engineer for the Invincible Oil Corporation has the facts and figures in an article starting on page 5.

Handling heavy oils with the Dubbs process. In covering this process, owned by the Universal Oil Products Company, Dr. Morrell gives an interesting summary on just what has been the results obtained from various oils.

Other features, including recent patents granted for refining methods, news notes on various refineries and plants and new equipment on the market.

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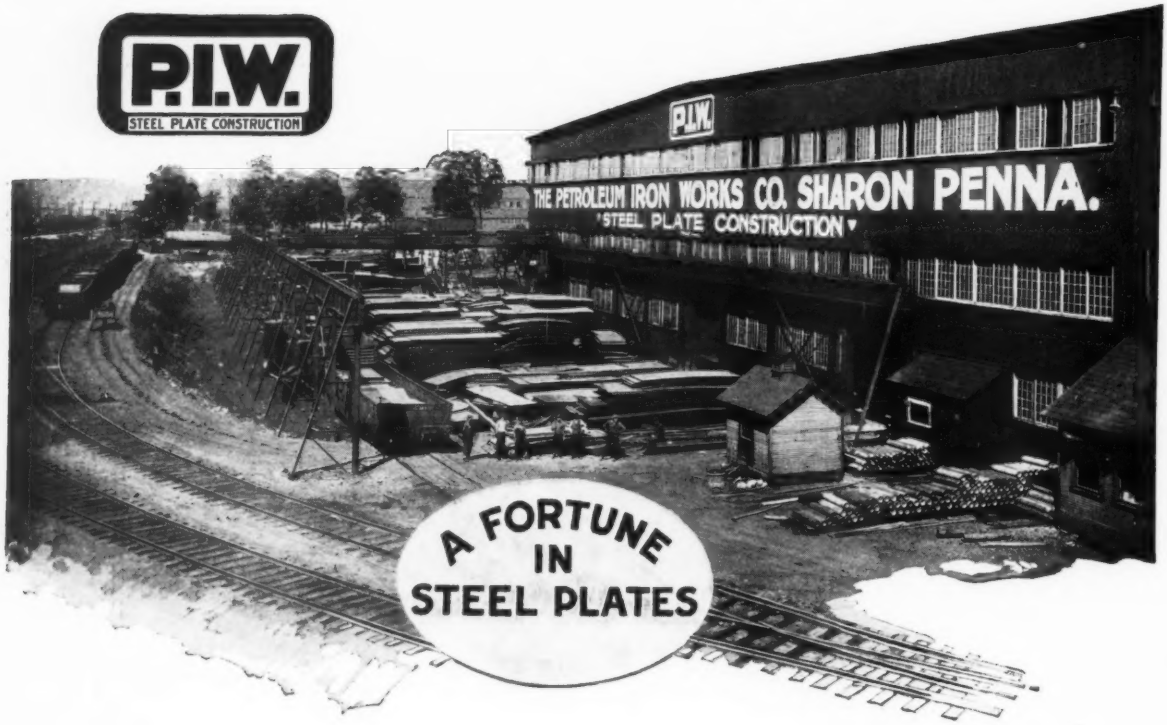

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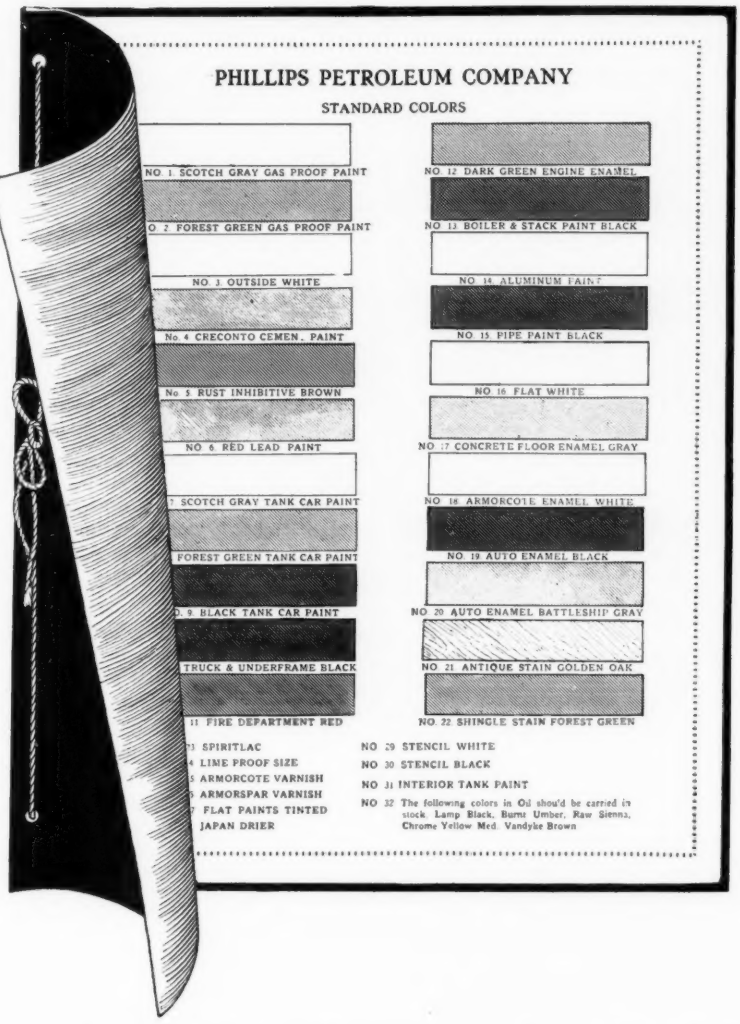
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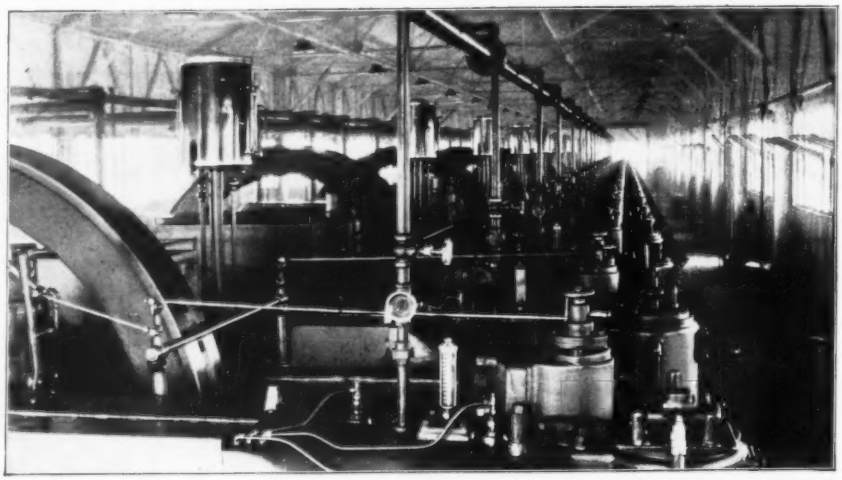

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Cracking—Or Making Your Oil Pay Dividends

Complete history of the process of destructive distillation with all the facts

By C. M. Johnson, M. E.
Chief Engineer Invincible Oil Corporation

ALTHOUGH petroleum is widely distributed, being found in many parts of the world, and although information as to occurrence and general characteristics seem to have existed from very early times, our knowledge of the chemical nature of this substance has been acquired largely within the past forty years. Within this period a voluminous literature has accumulated, which records work as painstaking as has ever been undertaken in the whole field of chemistry, but, despite this fact, the commercial method of treating crude petroleum for the purpose of procuring marketable products is, in the main, essentially empirical. Much knowledge has been acquired as to methods of separating from crude petroleum such products as are desirable commercially, but little has been done to attain the maximum recovery of such products.

The demand for motor fuel is outstripping that for illuminating oils and the increasing number of motor vehicles in operation, both in the United States and abroad, has brought about a need which, if it continues to increase at the present rate, will soon far exceed present production by ordinary means. The acuteness of this need becomes all the more evidenced when it is realized that a large proportion of the world's output of crude petroleum is of such a character as to produce by ordinary refining methods comparatively little gasoline and naphtha. The result is that the demand for these lighter fractions must be supplied by the types of crude petroleum generally classed "Refinable Crudes." Even refinable crudes are capable of yielding, by the usual refinery operating methods, only fractions of their total volumes as gasolne and naphtha.

From time to time the bringing in of a prolific oil field relieves the strain by the great outflow of refinable oil that follows, but the relief is only temporary, as the life of a gusher field is generally short. The rising market price of gasoline is the concrete evidence of present conditions. Thus, the discovery of new fields, which is daily becoming more difficult, can hardly furnish a solution of the problem of how to meet the ever-increasing demand for one of the products—crude petroleum. Even if crude oil could be obtained in sufficient quantity to meet the needs of the gasoline market an excess supply of less desirable products would be bound to result.

The fact that such a large proportion of the world's supply of crude petroleum seemed to be unsuited to the production of motor fuel has led a number of investigators to undertake to work out commercially practicable processes whereby yields of these products from a given quantity of refinable oil can be largely increased, or a more refinable oil be made to yield the desired products. It is obvious that if such processes can be successfully developed, a better effect will result than if the production of crude oil is proportionately increased. The supply of crude oil will be conserved, and the market will not be burdened with products of limited commercial use or unprofitable to produce. These processes, of which a number have been brought forward during recent years, involved "cracking" or decomposition of heavy oils—either low grade natural crudes or the heavier fractions of refinable crude—that have at present a low commercial value.

Cracking is at present in an early stage of development and an enormous mass of experimental work has evolved only a few commercially complete processes. The result of subjecting hydrocarbon mixtures to heat and pressure, which is called cracking, or destructive distillation, and which increases the yield of the lighter hydrocarbons, is known to have been recognized as early as 1861 when it is claimed its effect was accidently discovered in the operation of a still at Newark, New Jersey.

In the earlier days of the industry the desired object was kerosene or burning oils and the products of that time were known to have contained large amount of the lighter fractions. These fractions were not desired until the use of internal combustions created a demand for this class of fuel.

Its Early Use

As originally employed, the process was directed toward the conversion of that fraction of crude petroleum intermediate between the burning (kerosene) oils and the lubricating oils with liquid hydrocarbon products of lower density and boiling point, which would be suitable for use as illuminants.

The ordinary processes of refining crude petroleum yield a series of products differing widely in properties and commercial desirability. Those required for the smaller types of internal combustion engines, such as are now generally used in airplanes, motor boats, farm tractors, motor trucks and automobiles are in greater demand. Kerosene and fuel oil, which are used to produce light, heat, power in competition with other more plentiful resources, such as coal, are less desirable with regard both to commercial profit and the conservation of natural resources.

Of the two types of products used in internal combustion engines—lubricants and gasoline—the former does not seem as yet to offer a problem in the conservation of resources. Gasoline is, however, being produced in such quantities that its continued use on the present scale threatens to bring about the practical exhaustion of the country's underground supply of crude petroleum. There is no more important problem facing the industry today than that of conservation of this natural resource.

The conversion of all kerosene and fuel oil into gasoline is neither desirable nor possible, nevertheless, it is apparent that, for the present at least, the proportionate production of volatile distillates from crude petroleum should be increased. The most important means of accomplishing this end is the wider use of "cracking processes" which, although not entirely desirable from an economic point of view undoubtedly permit more efficient utilization of petroleum than would be possible at present if only the older types of refinery procedure were employed.

The cracking process is simply one instance of the well known tendency of organic substances to decompose on the application of heat. The heavier the hydrocarbon molecule, the more easily it is dissociated (separated). In actual fact, cracking to a greater or less degree is the rule rather than the excep-

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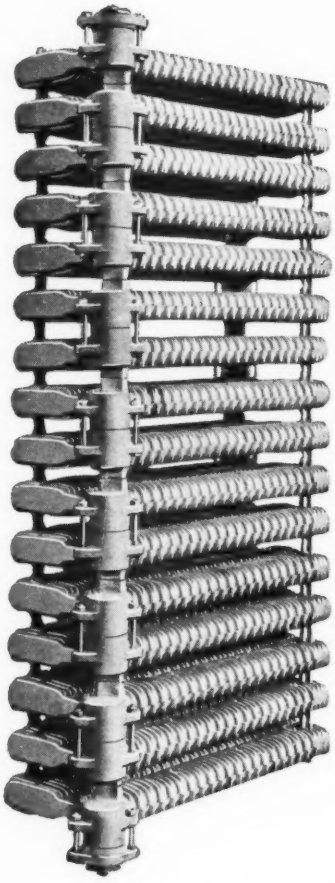

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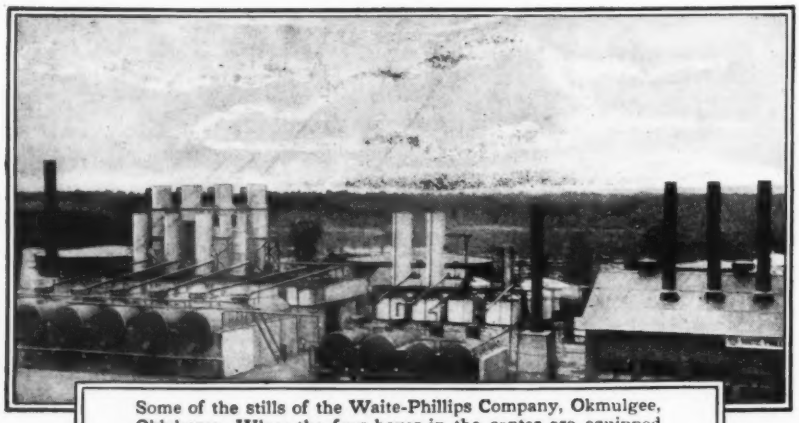


Some of the stills of the Waite-Phillips Company, Okmulgee, Oklahoma. When the four boxes in the center are equipped with Sterling Condensers, the entire plant will be 100% Sterling.

tion in the majority of distillation processes involving more than moderately low temperatures.

A natural hydrocarbon oil, or crude petroleum, is a mixture of substances of varying boiling points. Each of the hydrocarbons of high boiling point contained in such mixtures is, during the process of distillation, exposed to various degrees of temperature beyond its own boiling point so long as the hydrocarbons of lighter gravity and boiling point are not removed from the still. Consequently, the liquid hydrocarbons of high boiling point may remain exposed in the still to temperatures below their boiling point for a number of hours. For example, in general refinery practice, one to three days is necessary to complete a crude cycle, the exact period depending on the size of the still and the amount of hydrocarbons to be treated. This long exposure to a degree of heat below the boiling point of a particular hydrocarbon, resulting in its dissociation or partial alteration, constitutes "cracking." As time is an important factor in every organic reaction, the technical significance of the time the oil is exposed to heat becomes evident.

In the cracking of heavy oils two factors govern largely the course of the reactions that take place, namely, temperature and pressure. The functions of increased temperature is to break the bonds or groups that make up the complex hydrocarbon molecule. In many processes pressure is of chief importance in controlling the temperature of distillation, but it also exerts an influence on the nature of the decompositions produced.

The temperature at which dissociation takes place with the desired rapidity is usually above the boiling point of the hydrocarbon concerned. When no pressure is employed these hydrocarbons will vaporize and pass out of the reacting sphere, the degree of alteration being small. If, however, sufficient pressure is employed to raise the boiling point to a temperature causing more rapid cracking, alteration into desired product may be obtained with a minimum of total decomposition. As soon as the action begins to be a total decomposition, permanent gases will be evolved and both carbon and heavy asphaltic bodies will remain as residues. The volume of gas, therefore, if measured, is an approximate index of the degree of decomposition that is taking place. The cracking process involves, therefore, a partial alteration or dissociation, as distinguished from a more complete alteration or decomposition. The object of cracking is to alter the heavier molecules so that low boiling hydrocarbons will be produced that would not appear on ordinary distillation. Such a process may or may not be accompanied by an appreciable production of permanent gases, depending on the degree of alterations necessary to obtain the desired products. In a simple cracking process as high a temperature as is practicable within the limits of apparatus is desirable, in order to insure a high speed of reactions. A decrease in temperature below a given point will mean a decided increase in time. In commercial practice this would mean increase in operating costs. On the other hand, too high a temperature will mean a large production of extreme decomposition products, so that for results desirable commercially a mean temperature must be chosen that will cause the process to be complete at the maximum speed consistent with a relatively small production of permanent gases and carbon.

The object of any process must be to produce the maximum amount of a commercially desirable product at the lowest commensurate cost. The cracking process produces a mixture of various hydrocarbons which, to be available commercially, must have an initial boiling point not over 140° F. and an end point not over 450° F. with a gravity range of 50 to 58° Baume. The product must be water white in color, sweet in odor and staple in its composition. The use of heat and pressure for cracking is an old art and is not the subject of any existing basic patents. When combined with condensation under pressure it is subject to many patents, of which No. 1,049,667 issued to William Burton on January 7, 1913, and No. 1, 123,502, issued to J. A. Dubbs on January 5, 1915, are the earliest of present importance still in general use. These patent claims conflict as they are—to a certain extent—basic and of primary importance. The validity of Dubbs, whose application antidates Burton, is now in litigation between the Universal Oil Products Corporation and The Standard Oil Company of Indiana.

Classes

Cracking plants may be considered under three general methods:

1st. Subjecting liquid to both heat and pressure.

2nd. Subjecting vapors to heat with or without pressure.

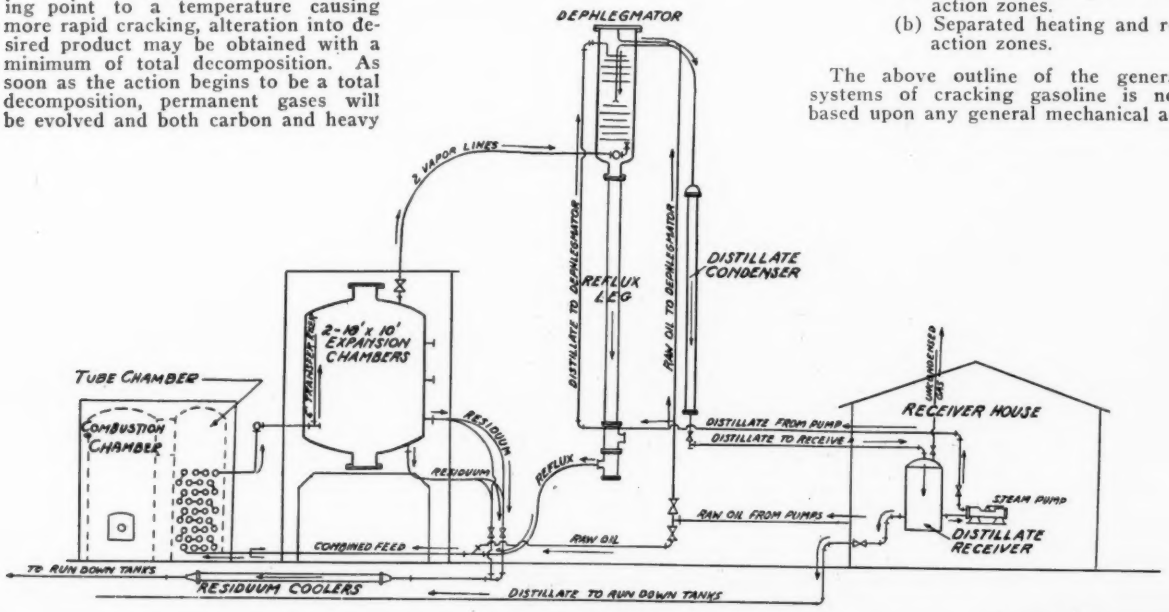
3rd. Heating liquid or vapor in the presence of a catalyst.

Roy Cross, in his Bulletin No. 16 of the Kansas City Testing Laboratory, classifies the various cracking systems as follows:

I. VAPOR PHASE—
- A. Atmospheric Pressure.
  - 1. High Temperatures (Pintsch Gas).
  - 2. Low Temperatures.
- B. Increased Pressures.
  - 1. High Temperatures (Rittman)
  - 2. Low Temperatures.

II. LIQUID PHASE—
- A. With Distillation (distillation necessary).
  - 1. Atmospheric Pressure
    - (a) without chemicals.
    - (b) with chemicals.
  - 2. Above atmospheric pressure—no differential pressures—Dewar and Redwood, Dubbs, Burton. Clark, Jenkins, Fleming.
  - 3. Very High Pressure—distilling at a reduced pressure.
- B. Without Distillation (necessarily high pressure).
  - 1. Intermittent.
  - 2. Continuous
    - (a) Identical heating and reaction zones.
    - (b) Separated heating and reaction zones.

The above outline of the general systems of cracking gasoline is not based upon any general mechanical ar-



SIDE ELEVATION

DUBBS PROCESS FLOW CHART

rangement. Most of the patents relating to the cracking of oil cover mechanical arrangement.

Those systems that heat the oil vapor at atmospheric pressure are principally used for making gas. On account of the low specific heat of the oil vapor the temperatures are very high and are not subject to exact control. The pioneering work in the cracking of oil was done in heating in the vapor phase under increased pressure. The really successful processes that have proved profitable are those in which the cracking is accomplished by applying the heat to the liquid phase of the oil.

The method by which a large proportion of the synthetic gasoline is now made is by distillation at pressures considerably above the atmospheric pressure. The reaction and distillation takes place in the same still. An enormous amount of refluxing is necessary and the gasoline must be removed as fast as it is formed. An enormous amount of heat is lost by reason of this refluxing and the reaction is considerably retarded, but nevertheless the distillation is a necessity as otherwise excessive pressures would develop. By the use of very high pressure more reaction can be accomplished in a shorter time and methods exist whereby this is done followed by distillation at a lower temperature. All processes of making gasoline which have not involved the treatment of the oil strictly in the liquid phase are said to have met with only a questionable degree of success. Cracking processes are, as yet, in the primary stages of commercial application. As a means of supplying the products most in demand their importance can hardly be over estimated. It only remains to discover the most efficient means of obtaining the maximum possible yield of the desired product from any particular oil. The ease and cheapness with which crude petroleum can be transported to regions lacking supplies of crude oil give particular value to cracking processes, as the cheapest and most readily obtainable oils may be subjected to cracking at the place of the greatest demand and most extensive use.

Much Prejudice

There has been considerable prejudice against the products of cracking processes. It is claimed that burning oils are inferior in light giving power and more easily acquire a dark color with age. The chief objection seems to be in the presence of the unsaturated hydrocarbon compounds which give an unpleasant odor and require the use of large quantities of sulphuric acid in the refining process which increases the cost of the finished product. The same prejudice seems to exist with respect to the cracked gasoline. Another objection to cracked gasoline is the alleged fact that such gasolines deposit larger quantities of soot in the cylinders of internal combustion engines but this deposit may or may not be caused by improper mixtures for proper and complete combustion. Certain investigations tend to show that a properly cracked gasoline gives a greater mileage than a straight run gasoline because of a slower burning quality giving power during the entire piston stroke as compared with the explosion occuring with straight distillates.

Therefore, there is reason to believe that instead of being inferior the cracked gasolines are really superior for use in automobile engines as regards both mileage and power obtainable, even though they lack some desirable properties and this suggests that a blend of "cracked" gasolines and the straight run gasolines may give greatly improved results.

The pressure distillation (liquid phase) type of cracking process is the one that seems to have been developed most extensively to date, and at present is the only one that is a factor of real commercial importance in the production of gasoline. Cracking by distillation without pressure is old and has been in use for years for the production of kerosene from heavier petroleum products. It was early discovered, by accident, it is said, that vigorously fired stills, constructed with plenty of surface for reflux condensation, were capable of cracking heavy hydrocarbons into distillates which were largely of the volatility range required for burning oils. The pressure distillation process was developed when gasoline, instead of kerosene, became the product most desired. The difficulties involved in the development and operation of the pressure distillation process were considerably greater than those that must have been encountered in the cracking distillation of kerosene, and the development of the Burton process is one of the important scientific achievements of the present day.

The other common type of thermal process is the so called vapor phase processes in which oil is cracked by passage through some sort of system, generally a tubular one, that is strongly heated. Whether the oil is completely vaporized previous to cracking during its passage through the heated zone is questionable, but as regards chemical behavior this type has characteristics indicating a single phase of vapor phase system. In the distillation type of process there is for each oil, a relation between temperature and pressure. With the vapor phase processes the two conditions of temperature and pressure can be fixed independently of each other and of the physical properties of the oil cracked, which, according to the phase rule, makes it possible to regard the cracking zone as a single phase or vapor phase system.

Vapor phase processes have been developed along commercial lines, with a number of modifications, but they seem to differ chiefly in mechanical and operating details, the fundamental mechanism seemingly being the same.

In a broad general way the vapor phase processes consist in passing a stream of oil through the heated zone of the system, this heated zone being maintained at a temperature high enough to bring about the desired degree of conversion. These processes practically always operate under pressure, although this is not an absolute essential as it is for pressure distillation processes. The temperatures usually measured are those of the cracked product leaving the heated zone and the figures generally specified in claims or descriptions are between 500 degrees Centigrade (932 degrees Fahrenheit) and 600 degrees Centigrade (1112 degrees Fahrenheit). As regards chemical action in vapor phase processes it appears that the gasoline formed by cracking is not removed continuously but remains with the uncracked oil during its entire course through the cracking furnace. The results in the exposure of the gasoline to cracking conditions for an appreciable interval of time after its formation gives an opportunity for recracking and consequent formation of permanent gas. On this account, as well as on account of the fact that the temperatures are undoubtedly higher than those effective in the pressure distillation type of process, the amount of gas formed per unit quantity of gasoline produced is higher in vapor than in the liquid phase processes.

The pressure distillation process is one that seems decidedly advantageous as to chemical kinetics. The temperatures maintained in the body of liquid oil are relatively low. The temperature of the metal surfaces that transmit heat to the oil is undoubtedly considerably higher, but the results of the process warrant considering it as operating at a relatively low temperature. The desired product, gasoline, is removed from the cracking zone practically as soon as it is formed. The gasoline is volatile under the temperature and pressure conditions maintained in the still and passes promptly into the vapor line. These conditions of low temperature and prompt removal of gasoline vapors favor a high yield of volatile liquid hydrocarbons with a minimum formation of these undesirable products—carbon and permanent gas.

Vapor vs. Liquid Phase

While the cracking of oils in the vapor phase would be highly desirable if the product in other conditions were satisfactory, the advantages of cracking in the liquid phase are many and are overlooked by investigators working in the vapor phase.

Some of the advantages are as follows: a lower temperature is sufficient to induce cracking. A higher yield of refined gasoline is obtained. There is a better economy of heat. (The thermal efficiency may be successfully compared with the generation of steam from water on one hand and the superheating of steam on the other. It being a very expensive operation to heat a vapor through a metal.) A more perfect control of temperature. Carbon deposits always in suspension.

The disadvantages chiefly concern operating conditions and sum up about as follows: A large amount of oil exposed to the heat in case of ruptures of the still; inability to use light distillates such as kerosene without using high pressures.

On the other hand, some of the advantages of cracking in the vapor phase are: The small amount of oil exposed to heat in the event of breakage resulting in a fire; the possibility of carying pressure and temperature independently of each other, enabling the vapor phase plant to crack successfully light distillates such as kerosene.

The disadvantages may be summed up about as follows: a majority of the processes operating in this phase are handicapped by the high temperature at which cracking elements must be maintained, which, combined with pressure, causes rupture of parts; formation of carbon on mechanical scrapers or stirrers which ultimately close the tubes; overheating of the atoms as come in actual contact with the wall of the tube, which causes decompostion, forming a permanent gas and carbon.

The difficulties of heating a gas or a vapor in a metal container are well

known and require no comment other than the fact that it is an expensive operation.

The subject of research has been seriously taken up by the oil industry only within the past few years and only a limited number of companies have recognized its commercial value. While the past decade has seen an enormous amount of research and invention, the present finds but few which may safely be designated as established processes. A conclusion which is soon reached is that no matter how promising a process may appear in the beginning, only extended plant operation determines its commercial success. The operation of the pressure still is approaching something like standard practice in many refineries, but even there has its limitations.

Processes Described

A brief description of some of the cracking systems now in use in the United States follows:

The Burton Process

Burton's first patent, No. 1,049,667, was granted January 7, 1913, and the process is extensively used at the present time by the various Standard Oil Companies. The development of this process marks one of the milestones in the history of petroleum refining and its originator merits the distinction of being the first to demonstrate that pressure distillation could be done safely and practically on a large scale. The Burton system, with its several modifications, uses the liquid phase method, heating the gas oil or fuel oil in shell stills (Burton) or in Heine type boiler stills (Clark) using thermo syphon circulating system and condensing the vapors under 4 to 5 atmospheric pressure. These systems have considerable carbon troubles, but the results obtained are the standard of comparison in the art.

Burton-Clark Process

The Burton-Clark still is rated at 210,000 gallons per month or approximately 165 barrels per day. A typical modified Burton still consists of a horizontal steel shell 10 feet in diameter by 30 feet long with 45 4-inch diameter tubes suspended by front and rear headers, very similar to the arrangement of a water tube boiler. The slope of the tubes is such that circulation is by thermo syphon and the carbon formed is removed from the heating zone and deposited in the shell. The tubes are exposed to the hot furnace gases while the shell itself is protected. Eight-inch vapor lines convey the vapors to aerial condensers which contain approximately 400 feet of 4-inch pipe. From this aerial condenser the vapors pass through a vapor heat interchanger to the water cooled condenser coils and thence to a receiving drum in the tail house. Here the condensed vapors settle partially filling the drum to a desired point. The uncondensed vapors collect under pressure in the upper part of the drum and through proper control valves are conveyed through high pressure or low pressure mains to the gasoline recovery plants or to fuel. The light distillate removed from the bottom of the drum is metered and passes on to the run tanks.

Raw oil entering the system is metered and is pumped through the vapor heat interchanger and vapor lines to the still. The reflux from the aerial condensers also return to the still through the vapor lines. The entire system operates under 75 to 85 pounds pressure and all controls are located within the tail house which is usually set above the condenser boxes.

The cycle is usually about 72 hours and it is claimed that 60 to 70 per cent of light distillate is obtained overhead from which 50 per cent of gasoline is secured. The residuum or pressure tar is removed at the end of the run and used for fuel. The carbon averages between 150 and 300 pounds per run and is removed manually.

The Standard Oil Company of Indiana controls these patents and licenses their use to responsible refiners on the basis of four-tenths of a cent per gallon of oil charged, or about 16.8 cents per barrel. They also stipulate that one third of the total production of gasoline from their apparatus be subject to their call upon 60 days notice.

Estimated Profits

Assuming 2000 barrels raw gas oil per day.
Units required, 12.
Estimated complete cost $600,000.00
Yield, 50% new navy gasoline.

Cost per 24 hours	
Labor, 3 Stillmen @ $6.00, 6 Firemen @ $5.50, 9 general labor @ $5.00 1 Superintendent @ $10.00	$ 106.00
Steam, 200 B. H. P. @ 50c	100.00
Water	50.00
Light, air, etc.	15.00
Maintenance and depreciation 20% on $600,000.00	330.00
Cleaning, $15 per still each 72 hours	54.00
Insurance 1%	16.33
Interest 6%	98.00
Taxes, 2% on 50% valuation	16.33
Royalty, 16.8c per barrel	336.00
Fuel consumed 10% @ $1.66	332.00
Treating and steam stilling @ 25c	350.00
Total daily estimated operation	$1,803.66

Yields

Gasoline 50%—1000 bbls. @ $5.67	$5,670.00
Fuel Oil 45%— 900 bbls. @ $1.66	1.494.00
Loss, 5%— 100 bbls.	
Total 100%—2000 bbls	$7,164.00

Costs

2000 barrels Gas Oil @ $1.95	$3,900.00
Estimated operation	1,803.66
	$5,703.66
Gross Revenue	$7,164.00
Operation	5,703.66
Net Daily Revenue	$1,460.34

$1,460.34 x 300 days equals $438,102.00 per year.
1000 barrels gasoline cost $1,494.00 or $1.49 per barrel.

The Dubbs System

The Dubbs system, assigned to the Universal Oil Products Corporation, the first patent of any importance being No. 1,123,502, dated January 5, 1919, operates in the liquid phase. It has certain advantageous features but appears to be only one of many possible forms of utilizing the same basic principles and the relative efficiencies of which are matters of perfection of engineering design and construction. Properly developed, it should give results comparable with other systems of the same general class.

The 500 barrel units which are considered standard plants consist of heating elements, expansion chambers, dephlegmator, condensing and cooling elements together with accumulator tank and pumping equipment. The heating elements consist of fifty 4-inch by 30 foot No. 4 gauge seamless drawn tubes connected at the ends by special return bends forming a continuous coil 1500 feet long containing approximately 1500 square feet of heating surface. These tubes are set within a brick setting with a separate combustion chamber fired at each end. The combustion gases pass over a partition wall, thence downward over the tubes to the flue and stock. The expansion chamber is a 10 foot diameter by 10 foot high hammer welded steel shell supported by a cast steel ring set upon a concrete pratform. This drum is heavily insulated to prevent excessive losses of heat by radiation. The dephlegmator is an upright steel cylinder approximately three feet in diameter by 12 feet high, supported by a structural steel framing and is set about 90 feet high to the top of the tower. The condensing elements are contained within a steel condenser box supported upon the roof of the control house. The control house is a concrete and brick structure housing the charging and transfer pumps together with the necessary indicating and recording instruments. The residuum cooling coils are set within a steel condenser box set upon the ground at some convenient point. Pipe, valves and fittings are designed to withstand the temperatures and pressures at which the system operates.

Raw oil from the storage tanks is pumped through the heating coils entering at the bottom and flowing upward in counter current with the gases of combustion. The heated oil, at about 120 to 160 pounds pressure and 750 to 850 degrees Fahrenheit temperature flows to the expansion chamber entering at the top. In this chamber the vapors are released passing on over to the dephlegmator. The carbon or coke builds up on the bottom of the chamber and the heavy residual fuel oil is continually withdrawn from above the level of the coke. The vapors enter the dephlegmator at the bottom passing upward, around and over a series of baffle plates where the heavier ends condense and reenter the system. The light vapors leave the tower at the top and pass through the condensing and cooling coils to an accumulator tank where the pressure is relieved and the pressure distillate passes on to the receiving tanks. The fixed gases are removed from the accumulator and may be passed through a compression or absorption system to secure an additional yeld of gasoline and afterward be used for fuel. These gases usually amount to around one and a half to three per cent on raw oil charged and contain two quarts of gasoline per 1000 cubic feet. The vapors leaving the dephlegmator are controlled to the desired temperature by charging overhead a portion of the pressure distillate produced. This charge enters the top of the tower and falls downward in counter current to the ascending vapors from the expansion chamber. This liquid cools the vapors and causes the heavier fractions to reflux back into the system and at the same time the vapors impart sufficient heat to vaporize the distillate. This constant refluxing and circulating secures a pressure distillate of desired quantity and quality. Varying the quantity and rate of raw input will affect the percentage of

gasoline yield, a large input securing a less yield than a small input. This refluxing really amounts to recycling of residual products. There is little or no carbon formed within the heating elements because of the continuous removal of the heavy fuel oil and the deposit of carbon in the expansion chambers. The relatively large amount of reflux, as compared with raw input, preheats the raw oil. Of the 500 barrels of raw input, 60 to 70 per cent may pass out as pressure distillate, 38 to 27 per cent as fuel oil, and two to three per cent remains as carbon.

Before the beginning of a run, chains are suspended and coiled within the expansion chamber. At the end of the run these chains assist in the breaking up of the coke deposit, thus affecting the time required in cleaning the receptacle. The length of a run depends entirely upon the amount of carbon formed within the chamber. When running on topped crude oil the cycle usually runs from five to six days and 12 to 13 pounds of coke is formed per barrel of raw oil. When running on gas oil this cycle varies from five to 15 days depending entirely upon the quality of oil.

Fuel consumption appears high, ranging from six to 12 per cent of the throughput but the results obtained seem to justify this item of expense.

The Dubbs patents are owned and controlled by the Universal Oil Products Company, whose main office is in Chicago, Illinois, with a branch office in New York City. The company charges a royalty of 15 cents per barrel of 42 gallons for oil subjected to treatment under the license.

Estimated Profits

Assuming 2000 barrels raw gas oil per day.
Units required, 4.
Estimated complete cost $260,000.00
Yield, 35% new navy gasoline.

Cost per 24 hours:

Labor, 6 Operators @ $6.00, 9 helpers @ $5.00, 6 firemen @ $5.50, 1 Superintendent @ $10.00.....$	124.00
Steam 120 H. P. @ 50c	60.00
Water	20.00
Light, air, etc.	10.00
Maintenance and depreciation 20%..	142.48
Cleaning	10.00
Insurance 1%	7.12
Interest 6%	42.74
Taxes, 2% on 50% valuation.....	8.12
Royalty @ 15c per barrel	300.00
Fuel consumed, 10% @ $1.66.....	332.00
Treating and steam stilling @ 25c..	280.00
Total daily estimated operation .....$	1,337.11

Yields

Gasoline 35%—	700 barrels @	$5.67..	$3,969.00
Gas Oil 35%—	700 barrels @	1.95..	1,365.00
Fuel Oil 25%—	500 barrels @	1.66..	830.00
Loss, 5%—	100 barrels	.....	.....
Total 100%—	2000 barrels		$6,164.00

Costs

2000 barrels Gas Oil @ $1.95 .....$	3,900.00
Estimated operation .....$	1,337.11
Total .....$	5,237.11
Gross Revenue .....$	6,164.00
Operation	5,237.11
Net Daily Revenue	926.89

$926.89 x 300 days equals $278,067.00 per year.
700 bbls. gasoline cost $1,337.11 or $1.91 per barrel.

The Greenstreet System

Greenstreet's first patent, No. 16,452, was granted in England in 1912. By this method the oil vapors are subjected to heat while traversing tubes in the presence of steam. The oil to be treated is first forced through preheating coils so arranged in the furnace that high temperatures in the liquid are not secured; steam is then added and the mixed oil and steam then enters the cracking coils where the vapors are subjected to the most severe temperature conditions. From the cracking zone the products leave the coils and enter expansion drums, one of which serves each cracking coil in the furnace. These tanks have the double purpose of equalizing pressures and of continuing the cracking of the oil. Leaving the expanding drums, the lighter vapors are reduced in pressure before they enter the condenser. The heavier products are drawn off from the bottom of the expanding drums. The pressure on the apparatus varies according to the nature of the oils run. The apparatus consists of a furnace in which there are placed six or more long flat coils of two inch tubing, each coil having a continuous length of 425 feet. These coils are suspended from steel beams at the top of the furnace in a way that facilitates easy removal and replacement. The wide range of liquids this system will handle makes it attractive to the refiner. It is merely requisite to adjust the pressure, temperature and rate of feed of steam and oil to get a variety of results and enable the refiner to manufacture products for which at the time there is the greatest demand.

It is claimed that when the conditions of speed, pressure and sufficient steam are properly coordinated, that there is never any carbon formed in the coils.

The Hall Process

Although developed by an American, this process was first tried on a commercial scale in the British Isles, being used throughout the war for the production of benzol and toluol from gas oils. In this country, the Texas Company has been interested in the process and has done considerable research. The apparatus in a broad way, resembles Greenstreet's but has the fundamental difference of operation in that steam is not used. The oil traverses the coil and is gradually heated until the most severe conditions are encountered at the outlet when the pressure is reduced to near atmospheric, the speed of the vapors reaching 5000 to 6000 feet per minute. From the expanding drums the vapors pass through a series of dephlegmating towers where several products of ranging boiling point are removed and finally to a compressor where the vapors are compressed and then cooled. Each coil is composed of 600 feet of one inch inside diameter tubing.

The Rittman Process

Nearly everyone is familiar with the principles of this method, and a detailed description is unnecessary. Suffice it to say that cracking takes place in the vapor phase in an upright tube. The method consists essentially in suddenly gasifying the material to be treated by atomizing into the top of the tube, cracking the gasified material in the absence of any liquid and under a pressure of at least six atmospheres. The vapors and tar are taken off separately from the tar pot at the bottom of the tube. Carbon is removed from the sides of the tube in the cracking zone by mechanical means.

This system is strictly a one phase system and as the pressure may be held constant and the temperatures varied or vice versa, this process is more elastic in its possibilities than any two phase process.

Aluminum Chloride Process

Perhaps the most conspicuous developments under the aluminum chloride process have been carried out by the Gulf Refining Company under the direction of Dr. A. M. McAfee. The oil is heated and stirred in a still in the presence of anhydrous aluminum chloride or other anhydrous salt of aluminum. Before treatment, the oil must be freed from water and a quantity of the catalyst equal to a maximum of eight per cent by weight of the oil charged is added before distillation is begun. Fractionating towers are interposed between the still and the condenser so that the higher boiling point vapors may be returned to the still along with the aluminum chloride which has been vaporized and carried over. The distillation is continued slowly at a temperature of 500 to 550 degrees Fahrenheit over a period of 24 to 48 hours. By this method a yield of 15 per cent or more may be obtained from residual oils. At the end of the distillation it is found that the aluminum chloride is enclosed in granular coke which is easily removed and that a heavy oil free from asphalt may be separated from the coke and then utilized for the production of high grade lubricating oils, the recovery of paraffin wax or the manufacture of petrolatums. The distillate secured is water white, of pleasant odor and in order to secure finished gasoline it is only necessary to wash with dilute alkali and water. The one difficulty suggesting itself as being inherent in this process is that of recovering the aluminum chloride or of manufacturing it cheaply. It is claimed that the products secured by cracking in the presence of catalysts are superior to those obtained by heat cracking processes.

Cross Cracking System

The cross units are rated at 500 barrels per day and consist of heating elements, reaction chamber, condensing and cooling apparatus together with accumulator tank and necessary pumping units.

The heating elements consist of two banks of tubes, the upper of preheating tubes and the lower or cracking tubes. Each bank consists of 28 four inch inside and five inch outside diameter, seamless drawn tubes 20 feet long, connected at the ends by cast steel return bends forming continuous coils. The cracking tubes are set in the brick setting directly above the combustion arch, and the preheating coils are arranged directly above them so as to absorb heat out of the flue gases. The reaction chamber, as now designed, is a gun forged steel cylinder 38 inches inside, 44 inches outside diameter by 40 feet long. The ends are swedged down to a smaller diameter than the body of the chamber. All apparatus is built to withstand a working pressure of 600 pounds at temperature ranging to 860 degrees Fahrenheit.

The raw oil is first pumped through the preheating coils entering at the top and flowing downward to the cracking tubes. No decomposition or cracking

takes place in this tank of tubes since they merely serve as fuel economizers. The preheated oil enters the cracking tubes at the bottom and flows upward to the reaction chamber. In this tank of tubes the main absorption of heat takes place while the pressure in the system is sufficient to maintain the oil in the liquid condition. The temperature and the character of the oil under treatment govern the rate of feed. The oil flows from the cracking coils to the reaction chamber where it is held a sufficient length of time to establish an equilibrium between the liquid and vapor phase, which is usually about fifteen minutes. A control valve is set at a predetermined liquid level and the oil passes out through the condensing and cooling coils under a pressure of approximately 40 pounds into the accumulator tank from which the gas is removed and used for fuel while the synthetic crude passes on to storage. This crude is then run in the ordinary skimming plant in the conventional manner. During the interval of time for conversion the carbon is dropped out in the reaction chamber and builds up on the bottom. In general practice 96 per cent of the raw oil passes on through the system to synthetic crude and four per cent is carbon, fixed gases and loss. Sufficient gas is generated within the system to provide fuel for the entire cracking operation. Reducing the synthetic crude usually yields 28 to 29 per cent of gasoline, and if the residual gas oil from this operation was recracked, additional yields of gasoline are possible. Figured on original gas oil the first run and on recycle yields approximately 43 per cent and a second recycle increases the yield to 51 per cent.

This process has a distinct advantage in its ability to successfully crack kerosene distillates and it can handle fuel oils, although the running time is materially shortened because of the deposition of carbon in the reaction chamber which is of limited capacity.

Tower stills are being added to the cracking units and it is claimed that the heat contained within the synthetic crude is sufficient to cause distillation, securing the benzine overhead and leaving a gas oil residuum. The usual cycle when operating on gas oil is 150 to 175 hours.

This system is controlled by the Gasoline Products Company of New York and Kansas City and is licensed to refiners for 10 cents per barrel of raw oil charged. The company has a working agreement with the Standard Oil Company of New Jersey, and the Standard Oil Company of Indiana whereby an interchange of patent rights on various processes might be of some value to a licensee.

Estimated Profits

Assuming 2000 barrels raw gas oil per day.
Units required, 4.
Estimated complete cost.....$230,000.00
Yield, 30% New Navy Gasoline.

Costs per 24 hours:

Labor, 6 Operators @ $6.00, 6 Helpers @ $5.50, 6 Firemen @ $5.00, 1 Superintendent @ $10.00, 3 Stillmen @ $5.00, 3 Firemen @ $5.00, 3 Pumpers @ $5.00	$ 154.00
Steam 75 B. H. P. @ 50c	37.50
Water	20.00
Light, air, etc.	10.00
Maintenance and depreciation 20%	126.03
Cleaning	15.00
Insurance 1%	6.30
Interest 6%	37.80
Taxes, 2% on 50% valuation	6.30
Royalty @ 10c per barrel	200.00
Fuel, 1% of 2000 barrels @ $1.95	39.00
Fuel, 9% of 1920 barrels @ $1.66	286.84
Treating and steam stilling @ 25c	200.00
Total daily estimated operation	$1,138.77

Yields

Gasoline 30%—	600 barrels @ $5.67	$3,402.00
Gas Oil 50%—	1000 barrels @ $1.95	1,950.00
Fuel Oil 10%—	300 barrels @ $1.66	498.00
Loss, 5%—	100 barrels	
Total 100%—	2000 barrels	$5,850.00

Costs

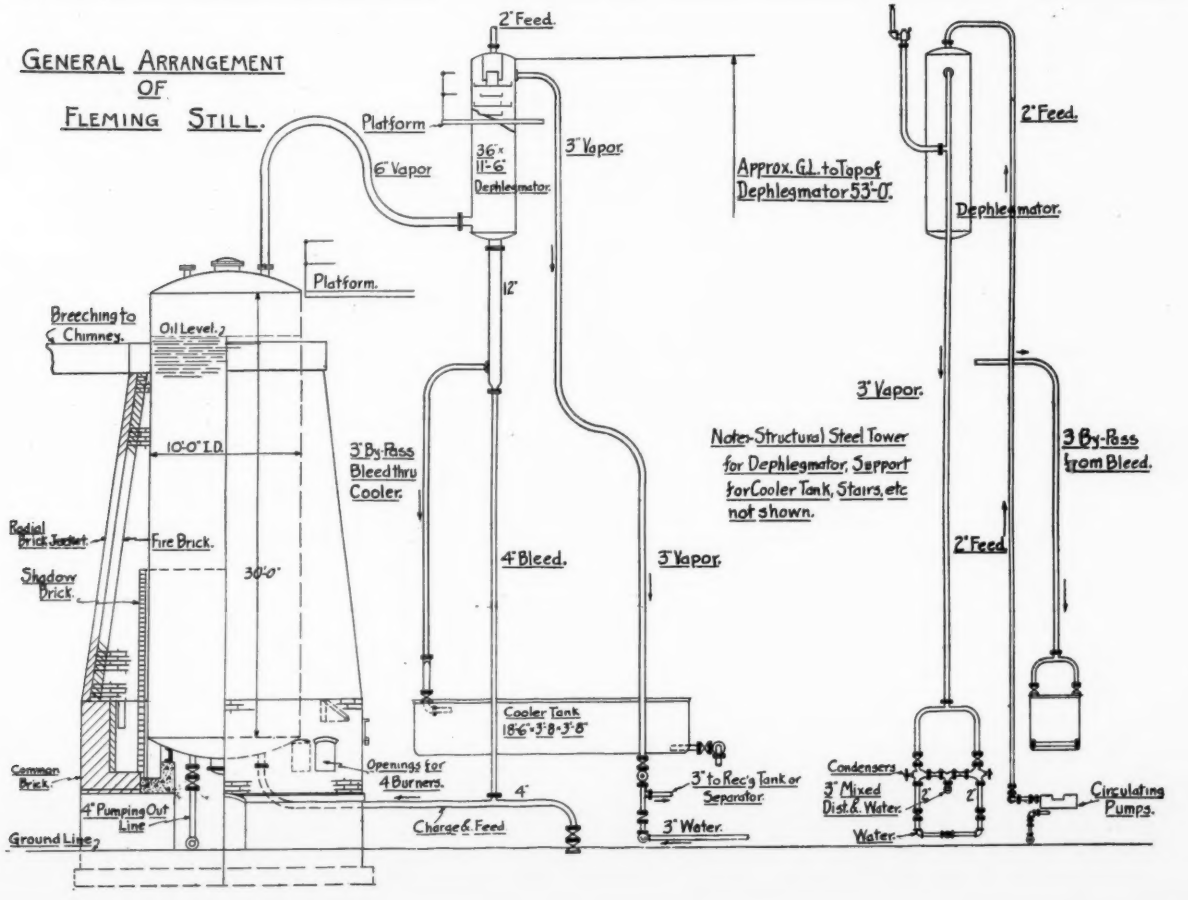
2000 barrels Gas Oil @ $1.95	$3,900.00
Estimated operation	1,138.77
Total	$5,038.77
Gross Revenue	$5,850.00
Operation	5,038.77
Net Daily Revenue	$ 811.23

$811.23 x 300 days equals $242,369.00 per year. 600 barrels gasoline cost $1,138.77 or $1.89 per barrel.

Fleming Cracking Process

The 200 barrel units which are considered standard plants, consist of an upright steel shell, dephlegmator, jet condenser, residuum cooling coils and necessary pumping equipment.

The still is a hammer welded steel shell, 10 feet in diameter by 30 feet high



made of one inch steel with heads one and one-eighth inches thick. This shell rests upon a cast steel ring which is supported by a concrete platform. This platform also carries a radial brick setting surrounding the still which tapers toward the top and terminates in a steel breeching and stack. Heat is generated through four burners set at equal distances around the circumference and that portion of the steel shell directly opposite to the flames is protected by a light curtain wall of fire brick. The upper five or six feet of the still projects through the setting and breeching and is heavily insulated. Inspection holes are located at convenient places for examining the shell. The dephlegmator consists of an upright steel cylinder three feet in diameter by 12 feet high which is supported by structural steel framing about 53 feet to the top of the tower.

The still is first charged with 300 barrels of raw oil which is gradually heated until the distillates come over. Raw stock is then charged over the top of the tower at a rate of approximately 250 to 275 gallons per hour, receiving a preheating from direct contact with the vapors. At the same time the heavy fractions are knocked down and only the lightest vapors pass over to the condensing and cooling apparatus. The preheated raw oil plus the reflux enters the still at the bottom and percolates through the body of oil in the still. To assist clean cutting by a positive control of temperature of the outgoing vapors, a certain amount of the reflux is cooled and pumped back over the top of the tower.

The overhead vapors which leave the dephlegmator are condensed in an apparatus of the jet type. The arrangement is such that a needle type valve releases the vapor between two cones of water. It is stated that the still pressure is maintained up to the needle valve, but that in the throat of the condenser itself there is no pressure—in fact, that there is a slight vacuum. The combined water and condensate is discharged into a separating tank where the water is drawn off and the fixed gases removed to be used as fuel.

The losses compare favorably with other processes and demonstrate the fact that there is no appreciable absorption of the gas by the water. The scrubbing effect of the water is also valuable, aiding materially in cleaning up the distillate and thus reducing later treatment.

The average cycle including cleaning is between 60 and 80 hours depending entirely upon the quality of raw oil fed into the apparatus. At the end of the run there is sufficient latent heat within the still to distill over between 100 and 150 barrels of gas oil, leaving a fuel oil of desired viscosity aond gravity.

This system is controlled by the M. W. Kellogg Company of Jersey City, New Jersey, who are the sole manufacturers, erectors and selling agents. The company charges $20,000 per still as a royalty to be paid out in two years. After this payment is made the licensee has no further assessments to pay.

Estimated Profits

Assuming 2000 barrels raw gas oil per day.
Units required, 10.
Estimated complete cost $390,000.00
Yield, 35% New Navy Gasoline.

Cost per 24 hours:

Labor, 6 Operators @ $6.00, 6 Helpers @ $5.50, 3 Cleaners @ $5.00, 1 Superintendent @ $10.00, ...	$ 94.00
Steam, 100 B. H. P. @ 50c	50.00
Water	50.00
Light, air, etc.	15.00
Maintenance and depreciation 20% ..	213.70
Cleaning	35.00
Insurance 1%	10.68
Interest 6%	64.12
Taxes, 2% on 50% valuation	10.68
Royalty (over 5 years @ $20,000.00 per still)	109.59
Fuel 10% @ $1.66	332.00
Treating and steam stilling @ 25c per barrel	235.00
Total daily estimated operations.....	$1,219.77

Yields

Gasoline 35%—	700 barrels @ $5.67..	$3,969.00
Gas Oil 35%—	700 barrels @ $1.95..	1,365.00
Fuel Oil 25%—	500 barrels @ $1.66 ..	830.00
Loss, 5%—	100 barrels	
Total 100%—	2000 barrels	$6,164.00

Costs

2000 barrels Gas Oil @ $1.95	$3,900.00
Estimated operation	1,219.77
Total	$5,119.77
Gross Revenue	$6,164.00
Operation	5,119.77
Net daily revenue	$1,044.23

$1,044.23 x 300 days equals $313,269.00.
700 barrels gasoline cost $1219.77 or $1.74 per barrel.

The Jenkins Process

The Jenkins Petroleum Process Company, a corporation organized and existing under the laws of the State of Wisconsin with headquarters at 208 South LaSalle street, Chicago, Illinois, own and control the following United States Letters Patent:

No. 1,216,526 U. S. Jenkins, May 15, 1917.
No. 1,321,749 U. S. Jenkins, Nov. 11, 1919.
No. 1,239,423 A. D. Smith, Sept. 4, 1917.
No. 1,247,883 Stephen Schwartz, Nov. 27, 1917.
No. 1,295,223 A. D. Smith, Feb. 25, 1919.
No. 1,324,075 A. D. Smith, Dec. 9, 1919.
No. 1,374,402 A. D. Smith, April 12, 1921.

and various other modifications and improvements which have not as yet been published.

The outstanding feature in the Jenkins system is the complete internal circulation of the entire liquid mass in treatment by mechanical means within the unit. In a means toward more complete destruction of the molecule but the circulation applied in these processes is one of pumpnig through units comprising tanks, lines, preheaters, reaction chambers, and back through lines into reservoirs.

The Jenkins patented cracking still is built very much on the order of the Heine type water tube boilers and are, at the present time, constructed by the Blaw Knox Company of Pittsburgh, Pennsylvania. The main drum is a hammer welded steel shell 72 inches in diameter by 35 feet long in the shell made up of 7/8-inch steel plate; the ends of which are closed with dished heads 15/16 inches thick. The Rear water leg is 36 inches in diameter and the front water leg is 40 inches in diameter, both made up of 1-inch plate which is flanged at the ends for field riveting to the main and transverse drums. The transverse drums at the bottom of the water legs are hammer welded six feet inside diameter by 10 feet long in the shell, made up of one inch steel and the ends are closed by dished heads one and one-eighth inches thick.

Manheads in the main drum are located in the center of the rear head and in the top of the shell directly above the front water leg. Each transverse drum is also provided with a manhead located in the center of a head—right or left hand as required. The manhead in the top shell is 18 inches in diameter while the balance are 24 inches in diameter.

The transverse drums are connected by one hundred and thirty 3½ inch No. 8 gauge sheiby seamless drawn calorized tubes about 17 feet long , which are rolled, pressed and beaded into the flue sheets. These tubes are set 7 inches on centers and are staggered. (At the American Gasoline Plant the stills are provided with two hundred and twenty six 3-inch tubes about 16 feet long which are set 23 rows wide by 10 rows high.)

The still is designed and constructed entirely in accordance with the American Society of Mechanical Engineers boiler code. They are designed for a working pressure of 150 pounds per square inch and 750 degrees Fahrenheit temperature. After erection and before the settings are erected, each still is subjected to a hydrostatic test of 225 pounds per square inch at 125 degrees Fahrenheit.

For batch charging and pumping out purposes there is a four inch connection in the head of the rear transverse drum located directly under the manhead. In the center of the opposite head there is a 3-inch nozzle used for draining the drum, also for a steam connection. In the top of the main drum about four feet from the rear head is an eight inch nozzle used for the vapor line connections. Six feet in front of the vapor nozzle and on the center line of the rear water leg is a 12-inch nozzle which supports the propeller driving mechanism. A four inch nozzle located near the front end of the shell is used for the pressure relief valve. On the center line of the rear head and along side of the manhead is a three inch nozzle used for the continuous removal of the fuel oil. The front head is provided with openings for gauge glass-pyrometer and steam lines.

The stills are set independent of the brickwork and are carried by three steel stirrups supported by structural steel framing. This framing also serves to support the operating superstructure.

The brick settings are so designed and constructed that only the tubes are subjected to the gases of combustion, the front and rear water legs, transverse drums and main shell being protected by brickwork.

A cast steel propeller of proper diameter and pitch is used to secure a positive circulation of the liquid within the still, thus securing a very efficient transfer of heat through the tubes from the gases of combustion to the liquid. This propeller is at the present time driven by a 30 to 50 Horse Power constant speed motor in direct connection with the shaft. Plans are being prepared to substitute a steam driving unit in place of the motor in order to secure the flexibility of varying speeds. The propellor driving mechanism is housed within a steel frame, corrugated iron building supported by the structural steel framing. A small steel frame, cor-

(Continued on page 20)

U. S. Refineries Using Cracking Processes

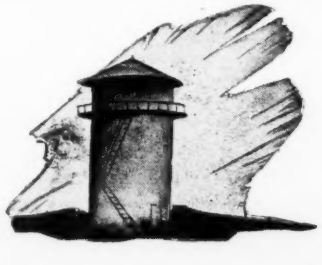
TO DATE there has been no published list showing what processes are used and the number of units in use by the various refining companies of the country. Realizing the value of such a list The Refiner and Natural Gasoline Manufacturer some time ago mailed out a questionnaire to the refining companies of the United States asking if they would be kind enough to furnish this information.

A large number of refineries responded and we wish to acknowledge at this time the assistance they have given us, and to thank them for it. Some plant executives did not reply or refused the information, but such refusals were extremely few.

Many of the questionnaires indicated that plants are contemplating installation of cracking processes, showing the keen interest that is universal in regard to the use of cracking processes.

Following is the data as we have been able to compile it:

Company, Plant and Location—	Process	Units or Capacity
Aetna Refining Co., Louisville, Ky.	Fleming	2
American Gasoline Co., Sheffield	Jenkins	..
American Oil Corp., Pioneer	Ryan Tower	..
American Oil Works, Titusville, Pa.	Fleming	1
American Refining Co., Wichita Falls	Dubbs	4
American Refining Co., Wichita Falls	Cross	2
Arkansas Oil Ref. Co., Ft. Smith, Ark.	Kalkhoff Tube Stills	..
Associated Oil Co., Avon, Calif.	Dubbs	1
Barnsdall Refining Co., Barnsdall, Okla.	Fleming	8
Big Six Ref. Co., Sapulpa, Okla.	Landes	..
British Burmah Oil Co.,	Cross	700 gal.
Butler County Oil Ref. Co., Bruin, Pa.	Bruin	4
C. & C. Refining Co., Centropolis	Cherry	..
Champlin Refining Co., Enid, Okla.	Fleming	..
Clayton Oil & Refining Co., Dallas	Cross	2
Coleman-Nelson Corp.	Cross	..
Constantin Ref. Co., West Tulsa,Okla.	Dietz	..
Cory Bros. & Co.	Cross	..
Cosden & Co., West Tulsa, Okla.	Coast	..
Cushing Ref. & Gas. Co., Cushing, Okla.	Christian Towers	..
The Derby Oil Co., Wichita, Kan.	Dubbs	4
Empire Refineries, Inc., Cushing, Okla.	New Oil Process	..
Empire Refineries, Inc., Okmulgee, Okla.	Coast	..
Globe Oil & Ref. Co., Blackwell, Okla.	Cross	400 gal.
Grant Oil Co., Augusta, Kan.	Jenkins	2
Grayburg Oil Co., San Antonio	Fleming	2
Grayburg Oil Co., San Antonio	Dubbs	2
Great Southern Prod. & Ref. Co., Shreveport La.	Forward	5
Hicock Refining Co.	Cross	..
Houston Oil Term. Co., Houston	Fleming	1
Humble Oil & Ref. Co., Burkburnett	Standard	..
Humble Oil & Ref. Co., Houston	Standard	1
Humphreys-Pure Oil Co., Smith Bluff	Cross	26
Independent Refining Co., Oil City, Pa.	Snodgrass	4
Indian Refining Co., Lawrencevill Ill.	Fleming	5
Inland Refining Co., Cushing, Okla.	Hansom	..
Interstate Gasoline Co., E. Chicago, Ind.	Greenstreet	1
Interstate Ref. Inc.	Cross	..
Johnson Oil Refining Co., Cleveland, Ohio	Dubbs	..
Elliott Jones & Co., San Antonio	Holmes-Manley	1
Kansas City Refining Co., Kansas City, Kan.	Own	..
Kendall Ref. Co., Bradford, Pa.		1
Leonard Oil ½ Gas Co., Newark, Ohio	Leamon	2
Lion Oil & Ref. Co., El Dorado, Ark.	Burton	..
Lubrite Refining Co., E. St. Louis, Ill.	Fleming	4
Magnolia Pet. Co., Beaumont, Texas	Burton	120 stills
Marland Oil Co., Ponca City, Okla.	Fleming	18
Midway Refining Company	Cross	700 gal
Miller Pet. Co., Wichita Falls	Cross	1
Miller Pet. Co., Humboldt	Cross	1
Moore Ref. Co., Arkansas City	Dubbs	4
Mutual Ref. Co., Warren, Pa.	Snodgrass	3
National Ref. Co., Coffeyville	Setzler	..
Noble Oil & Gas Co., Burkburnett	Van Tilburg Towers	..
New Orleans Ref. Co., Good Hope, La.	Dubbs	2
North American Ref. Co., Rosedale	Cross	..
North American Ref. Co., Pemeta	Parker	..
North Star Oil & Ref. Co., Minneapolis	Van Tilburg	3
North Star Oil & Ref. Co., Winnepeg	Van Tilburg	6
Nyanza Ref. Co., Wilson, Okla.	Dubbs	..
Ohio Valley Ref. Co., St. Marys, W. Va.	Snodgrass	..
Oil Refiners Co. of Colorado, Denver, Colo.	Danckward	..
Oil State Ref. Co., Enid, Okla.		
Omah Ref. Co.	Cross	350 gal
Oriental Oil Co., Dallas, Texas	Floyd	3
Osage-Upton Oil Co., Osage, Wyo.	Linton	1
Panhandle Ref. Co., Wichita Falls	Dubbs	2
Penn American Ref. Co., Oil City, Pa.	Fleming	4
Petroleum Ref. Co., Latonia, Ky.	Cross	..
Phillips Co., Waite, Okmulgee	Cross	..
Pine Bluff Ref. Co., Pine Bluff	Blaisdell	..
Pioneer Pet. Corp., Guthrie, Okla.	Holmes	1000 Bbls.
Pioneer Pet. Corp., El Dorado, Ark.	Holmes	1000 Bbls.
Portland Oil & Ref. Co., Portland, Ind.	Fleming	1
Producers & Refiners Corp., West Tulsa	Coast	..
Pure Oil Co., Ardmore, Okla.	Dubbs	4
Pure Oil Co., Cushing, Okla.	Van Tilburg Towers	..
Pure Oil Co., Heath, Ohio	Cross	4
Pure Oil Co., Smith Bluff, Texas.	Cross	26
Ranger Ref. Co., Centropolis	Muehl	..
Rock Island Ref. Co.	Cross	..
Root Refineries, El Dorado	Dubbs	..
Royal Dutch Shell	Cross	800 gal
Santa Fe Carbon Co., Santa Fe Springs	Parker	1500 Bbls.
Santa Fe Carbon Co., Long Beach	Parker	1500 Bbls.
Santa Fe Oil & Ref. Co., Ardmore, Okla.	Dubbs	..
Sapulpa Ref. Co., Sapulpa, Okla.	Cross	1200 gal
Seneca Oil Works, Warren, Pa.	Snodgrass	2
Shaffer Oil & Ref. Co., Cushing, Okla.	Dubbs	..
Shell Co. of California, Martinez	Fleming	1
Sheridan Ref. Co., Newkirk, Okla.		..
Shreveport Prod. & Ref. Co., Shreveport.	Christman Towers	..
Shreveport Prod. & Ref. Co., Shreveport, La.	Dubbs	2
Sinclair Ref. Co., Argentine	Isom	..
Sinclair Ref. Co., Coffeyville	Isom	..
Skelly Oil Co., El Dorado	Cross-Jenkins	..
Solar Ref. Co., Lima, Ohio	Burton	60
Southern Ref. Co., Somerset, Texas	Fleming	1
Standard Oil Co. (Cal.), Richmond	Standard	10
Standard Oil Co. (Kan.), Neodesha	Burton	..
Star Ref. Co., Fort Worth	Fleming	1
Sterling Oil & Ref. Co., Wichita.	Fleming	6
Sterling Oil & Ref. Co.,	Dubbs	4
Sun Company	Cross	400 gal
Texas Co., West Tulsa, Okla.	Holmes-Manley	..
Texas Co., Port Arthur.	Holmes-Manley	..
Texas Oil Prod. Co., Waxahachie	Ramage	..
Texas Pacific Coal & Oil Co., Wynnewood	Dubbs	..
Texahoma Oil & Ref. Co., Wichita Falls.	Dubbs	4
Thrift Oil Ref. Co., West Dallas	Floyd	2
Tidal Ref. Co., Drumright.	Burton	..
Titusville Oil Works, Titusville, Pa.,	Fleming	1
Transcontinental Oil Co., Fort Worth	Slagter	1
Transcontinental Oil Co., Bristow	Slagter	..
Turley Ref. Co., Oklahoma City	Korman	..
Union Pipe Line & Ref. Co., South City.	Dubbs	1
United States Oil & Ref. Co., Osage, Wyo.	Cross	350 gal
Vacuum Oil Co., Paulboro, N. J.	Fleming	5
Vickers Pet. Co., Potwin.	Dubbs	..
Vulcan Oil Ref. Co., Coropolis, Pa.	Dubbs	1
Waite Phillips Co.	Cross	400 gal
Warner Grinlan Co., Warner, N. J.	Dubbs	2
Waverly Oil Works Co.	Cross	350 gal
White Eagle Oil & Ref. Co., Augusta.	Burton	..
White Eagle Oil & Ref. Co., Fort Worth.	Holmes-Manley	1



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Handling Heavy Oil With Dubbs Process

Condensation as well as cracking reaction is carried on under generated pressure

By Jacque Morrell

THE INTRODUCTION of cracking processes in the oil industry has brought about a situation where eventually an equilibrium will be reached between the price of crude based on actual gasoline content, and that based on the potential yield of gasoline.

The advent of the Dubbs process has determined the so-called low grade crudes and heavy residual oils on such a competitive basis as producers of gasoline that the inevitable result will be a substantial narrowing of the present margin between the high gravity and low gravity crudes in order that such an equilibrium may be established.

The cracking of heavy oils such as low grade residual oil, topped crude and fuel oil, owing to high coke forming properties, has never been commercially accomplished until the advent of the Dubbs cracking process. The heavy oils predominate in point of quantity production, and the full economic utilization of heavy crudes, such as Texas coastal, Healdton Panuco, Venezuela, Argentina, Smackover, California, etc., as well as topped crudes and fuel oils, could not be realized without resorting to cracking.

An increasingly large proportion of the present gasoline production is of the cracked type. According to United States Bureau of Mines reports the production of gasoline for the first seven months of 1923 was 4,392,025,353 gallons, representing an increase of 29 per cent over the production for the same period during 1922.

The importance of the Dubbs cracking process as a factor in gasoline production may be judged by the fact that its yearly production rate at this writing is over 294,000,000 gallons of gasoline, or over 29 per cent of the increase cited above.

The limitations of vapor phase and catalytic processes in the production of gasoline are too well known to require pointing out here. The use of shell still processes requiring direct firing or application of heat externally is limited to special gas oil cuts of low coke forming properties. There is the added fire hazard due to the large quantity of oil in the retort. Limitations are also imposed upon the high pressure processes of the tube and chamber type, owing to the coking of the outlets and the connections as well as chamber volume limitations for storage of coke.

All of the above weak points involve danger factors inherent in the types cited above. They are noticeably absent in the Dubbs process.

Basic Principles of the Process

a. Condensation, as well as the cracking reaction, is carried on under a generated pressure.

b. The original charging stock and reflux condensate only are circulated through the heating coil. The heavy residual oil remaining in the reaction chamber with any mechanically suspended coke forming particles which the residuum may contain is withdrawn continuously from the chamber.

c. The heating tubes are indirectly fired, exposing the tubes to the mildest furnace conditions.

d. Only the oil in the heating tubes is in the firing zone. No heat is applied to the reaction chamber. It is insulated, receiving all of its heat through the transfer of the oil from the heating tubes. This eliminates the fire danger due to hot spots and overheating.

e. The coke formed is deposited in this reaction chamber, which, as indicated above, is entirely free from the hazards usually attending such deposition. One of the important functions of this chamber is its use as a reservoir for the coke, and coke forming substances.

f. The total amount of oil in the entire system at any one time averages about 35 barrels. Only about one-third of this quantity is in the firing zone. This contrasted with 200 to 350 barrels as in the shell type of still gives a high safety factor with regard to fire dangers.

g. The operating or conversion conditions are very moderate, the average transfer temperature being about 840° F. with an average pressure of only 120 pounds, not as high as frequently used in ordinary steam boiler practice.

h. The process is continuous, the duration of a run being limited only by the storage capacity for coke in the reaction chamber. The length of run is determined by the amount of coke formed, and this is, of course, dependent on the type of oil cracked.

Equipment and Operation

A standard Dubbs unit has a daily capacity rated at 500 barrels of raw oil charging stock. It consists of a side fired furnace having two compartments, one for firing and the other for heating containing the coil. The hot gases of combustion from the firing zone pass to the heating compartment down over the heating coil counter current to the flow of the oil. The heating coil consists of 50 cold drawn seamless steel tubes each four inches in diameter and 30 feet in length connected in series with drop forged return bends, a total of 1500 feet in the coil. Aluminum bronze threaded plugs are easily removable from the return bends at the end of the run for inspection and cleaning of the tubes.

The raw oil charging stock is pumped from the supply tank either directly to the heating coil or through the dephlegmator, which under these conditions acts as a heat exchanger. At the start of a run the oil is recirculated from the reaction chamber back to the supply tank until cracking begins, and the pressure is allowed to buid up until the operating pressure is reached.

The hot oil discharged from the heating coil into the chamber where the coke, which is a product of the reaction, is deposited. The unvaporized residual oil is continuously withdrawn from the bottom or side of the chamber through the several residuum lines to a cooling coil and then to storage. The reaction chamber is 10 feet in diameter by 15 feet high, with a manhole top and bottom closed by flanged covers. As explained previously this chamber has no heat applied whatever, but receives its heat solely through the oil transfer. It is thoroughly insulated to maintain the required temperature.

The cracked vapors pass through a vapor line to an elevated dephlegmator containing perforated pans. The heavy ends or higher boiling point components are partially condensed here, and returned by gravity flow through a reflux leg to the heating coil. The average temperature of the oil in the bottom of the dephlegmator is about 740 degrees so that on joining the raw oil the mixture entering the heating tubes is about 600 degrees Fahrenheit. The cracked vapors leaving the top of the dephlegmator pass to a water cooled final condenser into the pressure distillate receiving tank.

The composition and nature of the overhead products are controlled at the will of the operator. To accomplish this, part of the cracked distillate is pumped back over the top of the dephlegmator merely acting as a cooling medium. The quantity of such distillate which is pumped back determines the outlet temperature of the vapors leaving the dephlegmator. Heat removal is effected both by the cooling effect of the distillate as well as its latent heat of vaporization.

The pressure upon the system is controlled by a needle valve connected to the pressure distillate receiving tank. The pressure control as well as all other operating control is directed from the receiver house by one operator in charge of two units. Operation of the plant is extremely simple and the labor item low.

The critical points in the operation are: (1) the transfer temperature, i. e., the temperature of the oil leaving the heating coil to the expansion chamber. This temperature averages about 840 degrees Fahrenheit, varying with the type of oil treated. (2) The temperature of the vapors leaving the dephlegmator. This is controlled as stated previously by recirculating a predetermined quantity of pressure distillate entering near the top of the dephlegmator. An alternative method is to pass the raw feed through the dephlegmator, or split the feed. This temperature would average about 540 degrees Fahrenheit, varying with the type of distillate desired. (3) The pressure; controlled as previously explained by a needle valve. Excess uncondensable gas is returned to the furnace to be burned as fuel. (4) Pressure distillate draw off. All of the above are under the direct control of the operator.

Temperature recording instruments and pressure gauge are provided for all the above factors. In addition, instruments are also provided for recording

TABLE NO. 1
Summary of Continuous Runs Made on Various Oils

	Louisiana Fuel Oil	Louisiana Topped Crude	Kentucky Fuel Oil	Mexican Distillate	Panuco Crude	Residuum from Venezuela Crude	Tarakan Crude (Borneo)
Charging Stock—							
Barrels treated	2,007	969	924	1,070	716	974	1,199
Be. Gr.	26.9	28.9	25.5	21	12.6	13.4	18.2
Percentage Coke (A. S. T. M. Dist.)	3.8	3.5	5.1	3.4	15.2	14.1	5.1
Gasoline—							
Per cent	36.8	41.6	43.9	41.65	23.7	26.9	32.43
Initial boiling point	121	122	112	120	126	108	106
End point	437	436	437	437	437	437	437
Pressure Distillate—							
Barrels	1,029	582	552	588	220	375	727
Per cent	51.3	60	59.7	54.95	30.8	38.5	60.62
Be. Gr.	54.0	53.6	54.8	53	49.7	48.9	38.1
Residuum—							
Barrels	916	331	319	412	450	508	345
Per cent	45.6	34.12	34.5	38.52	62.9	52.2	28.77
Be. Gr.	22.5	22	16.5	5.4	8.6	7.9	2.1
Coke—							
Pounds	23,620	15,022	20,000	19,510	11,020	25,800	27,438.5
Per cent by weight of oil cracked	3.77	5.03	6.87	5.62	4.48	7.75	6.92
Uncondensable Gas—							
Cubic feet	340,570	183,300	170,828	252,700	78,779	132,543	376,270
Operating Pressure—							
Pounds per square inch	120	120	120	120	105 to 120	105	120 to 135

the furnace, combined feed and residuum temperatures. All of these are installed in the receiving house within sight of the operator. Oil and gas meters are also provided for the measurement of charging stock and uncondensable gas. All liquid measurements are checked by tank gauges.

When the running conditions are settled the control valves may be set, and only occasional adjustments need be made. Operation is so flexible that even should the charging pump be shut down for a considerable period, the clean reflux passing through the tubes would prevent coking up of the transfer line during any temporary emergency. Duplicate pumps, however, are provided in the standard installations.

The coke which deposits in the reaction chamber is broken up by means of a chain in the chamber, around which the coke is formed, and at the end of the run the chain is pulled by means of a power hoist. Preliminary to pulling the chain, the system is drained and steamed.

Commercial Performance of the Dubbs Process

As an example of the performance of the Dubbs process in commercial production, it may be pointed out that in a series of consecutive and continuous runs in four 500 barrel units at rated capacity or over; unit No. 1 cracked 59,051 barrels of Mid-Continent gas oil with an average gravity of 34.2, producing an average yield of gasoline of 40.2 per cent; No. 2 cracked 62,967 barrels of Mid-Continent gas oil with an average gravity of 34.2, producing an average yield of gasoline of 41.4 per cent; No. 3 cracked 62,982 barrels of Mid-Continent gas oil with an average gravity of 36.3, producing an average yield of gasoline of 40.1 per cent; and No. 4 cracked 62,645 barrels of Mid-Continent gas oil with an average gravity of 34.2, producing an average yield of gasoline of 40 per cent.

The results upon fuel oil are equally as good, but more noteworthy, as an example of this may be cited continuous and consecutive runs made upon 19,022 barrels of a 25 Baume gravity Mid-Continent fuel oil producing an average yield of 41.5 per cent gasoline, with a fuel consumption as low as 1.07 per cent in addition to the uncondensable gas burned.

The process is extremely flexible in the handling of various types of charging stocks, the range being represented on the one hand by a 40 Baume gravity kerosene distillate to a 10 Baume gravity Panuco residuum on the other. As an example of what may be done with kerosene distillate, nearly 3000 barrels of this type of oil was treated continuously producing in excess of 50 per cent of a 410 degree Fahrenheit gasoline, with an average of throughput of 500 barrels per day. No carbon whatever was deposited in the heating tubes.

The following table shows the results obtained upon various types of oil which have been handled by this process. In addition to those shown in the table, splendid results have been obtained upon Smackover crude and California oils of varying types.

Primary Products of Cracking

1. Pressure Distillate. The pressure distillate produced has a good color. It varies in gravity dependent on the type of oil cracked as well as the per cent of gasoline contained therein. The temperature conditions in the dephlegmator are maintained so as to usually yield a pressure distillate averaging from 46 to 54 degrees Baume gravity, and containing from 60 to 80 per cent of gasoline. The method of treating this pressure distillate has been described in a previous publication,[1] but a generalized method which can be used for all types of pressure distillate, and especially for those cracked distillates with high sulphur content such as those produced from Mexican and South American oils is described below:

a. Water wash and in some exceptional cases a wash with dilute alkali.

b. Heavy plumbite treat using sulphur or other precipitating agent followed by water wash.

c. Water acid followed by three to 10 pounds of 66 degree Baume sulphuric acid per barrel of cracked distillate depending on the type of oil.

d. Water wash after drawing off acid sludge, three-quarters to one and one-half hour period for batch treatment.

e. Caustic treat for neutralization, using relatively small quantity of six to 12 degree Baume gravity caustic.

f. Water wash, five to 10 minutes.

g. Distillation preferably with fire and steam; or steam alone.

h. A final wash with caustic soda to render the product sweet.

From a viewpoint of economy in avoiding unnecessary refining, treating and distilling losses the following is recommended:

a. Continuous treating systems should be used. If batch agitators are already installed some type of circulating device such as a centrifugal pump should be used instead of blowing with air.

b. Stills should be equipped with fractionating towers or columns, and vapor recovery systems. There is a wide difference in the efficiencies of various types of towers. Batch stills should be run by a semi-continuous method feeding through the tower, or part of the distillate recirculated through the tower.

2. Residuum. The residual oil resulting from the cracking has very desirable fuel characteristics among which are a low cold test, relatively low viscosity and a high calorific value. The suspended coke forming particles present may be removed by settling. Other means are also available for their removal.

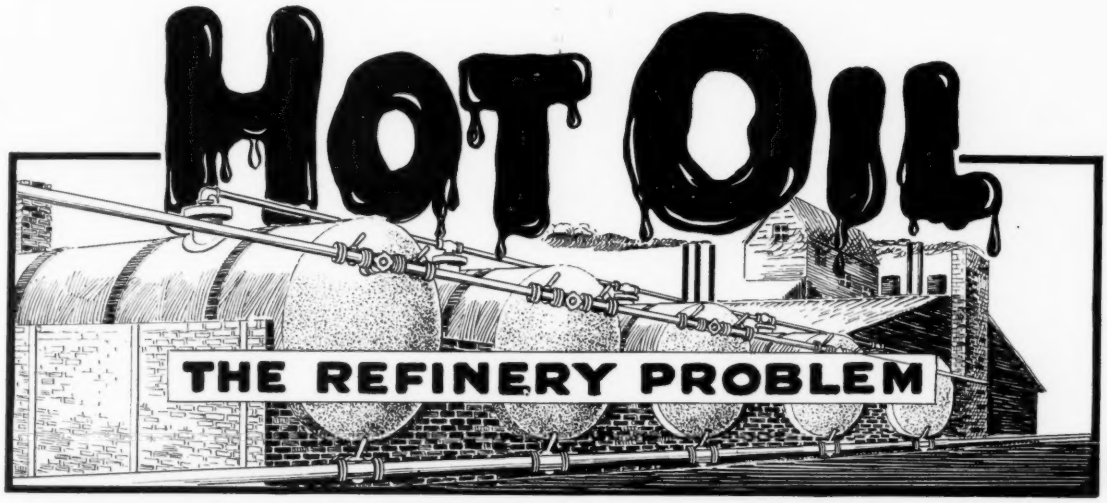
As an example of the fuel characteristics of these cracked residual oils compared to the charging stocks from which they are derived the following table is shown:

Table No. 2

	Be. Gr.	Cold Test	Viscosity Univ. Saybolt (100° F) Sec.	B. T. U. Per Gal.
Mexican Gas Oil	26.2	—49° F	50	
Residuum from Mexican Gas Oil	17.4	—45° F	66	147,570
Mid-Continent Fuel Oil	27.0	+56° F	181	147,670
Residuum from Mid-Continent Gas Oil	20.6	— 2° F	205	149,190
Burkburnett Fuel Oil	23.2	+63° F	347.5	145,870
Residuum from Burkburnett Fuel Oil	21.2	— 4° F	144	148,080
Louisiana Fuel Oil	14.0	+36° F	10,257.0	148,380
Residuum from Louisiana Fuel Oil	4.0	—20° F	423.0	157,850

(Morrell & Egloff, The Refiner and Natural Gasoline Manufacturer. Vol. II, No. 4, April, 1923.)

[1]Morrell & Egloff, Refiner and Natural Gasoline Manufacturer, Vol. II, No. 7, July, 1923.



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3. Coke. The coke produced in the process is of a porous nature, quite dry, with a high calorific value suitable for fuel purposes. The ash content usually averages about one per cent and in some cases is as low as one-tenth of one per cent. The calorific value varies from 15,000 to 16,000 B. T. U.'s per pound, which compares very favorably with the best grades of anthracite coal, and is very much better than the highest grades of bituminous coal. The quantity of coke produced, depending on the type of oil and operating conditions, usually varies from one-half to five per cent by weight of the raw oil, indicating a considerable economic item of substantial commercial value.

4. Uncondensable Gas. The amount of uncondensable gas produced per barrel of oil treated averages about 160 cubic feet measured at atmospheric pressure. The amount is dependent upon the type of oil cracked, and the operating conditions. The volume varies inversely as the pressure, a fact which must be considered in drawing conclusions from published figures. The calorific value varies from 1100 to 1300 B. T. U.'s per cubic foot.

The gas shows an average composition of an unsaturate hydrocarbon content of eight per cent, hydrogen about four per cent and paraffin hydrocarbon about 87 per cent. The composition varies with the type of oil being cracked and with operating conditions. Hydrogen sulphide will also be present where the charging oil contains sulphur.

The great flexibility of the Dubbs process with regard to the types of charging stocks handled, and ease of operation, as well as the low operating costs and the high yields per unit throughput, in a great measure account for its remarkable success.

"New Era" Gasoline-Water Separator

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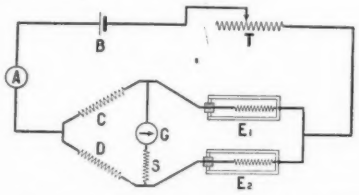
Brown Instrument Has Carbon Dioxide Meter

The measurement of carbon dioxide in flue gas is possible through the Brown electrical indicating and recording carbon dioxide meter, recently placed on the market by the Brown instrument company of Philadelphia, Pennsylvania. This meter is designed to provide means of gaining efficient combustion of fuels through accurate knowledge of the combustion products.

Quoting from a recent communication from the company, the new meter is described:

"This instrument works on the principle of the difference in thermal conductivity of various gases instead of on the principle of chemical analysis.

"This new electrical recorder permits of indicating and recording the percentage of carbon dioxide at any distance from the boiler, and a combined instrument records both the temperature of the flue gas and the carbon dioxide on one chart. This instrument shows continually the percentage of carbon dioxide and not the results of the analysis of a sample.



"Referring to the accompanying illustration (C) and (D) are the ratio coils while (E_1) and (E_2) are two small and identical platinum spirals mounted in the gas chambers or cells. Current from the storage battery (B) controlled to a constant value by the rheostat (T) sub-divides and passes through these fine wire spirals. If the gases surrounding the two wires are alike in thermal conductivity, the cooling effects by conduction to the metal cell walls are equal. Consequently, the spiral platinum resistances attain the same temperatures and the bridge remains balanced. If, however, the gas under test differs from that used as a comparison standard, the bridge is thrown out of balance and the galvanometer (G) deflects according to the magnitude of the unbalancing.

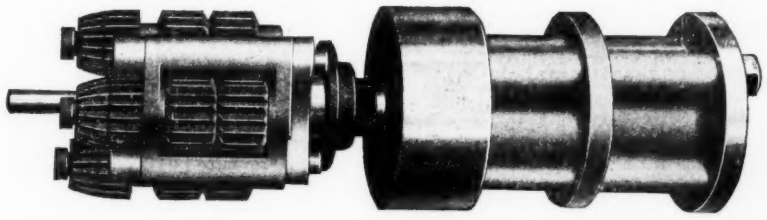
"In practice, one cell is filled with air and sealed for the comparison standard. The other cell is exposed to a flow of the flue gas under test. Since the thermal conductivity of CO_2 differs from that of air by approximately 40 per cent it is possible to calibrate the equipment in terms of CO_2 percentage. The other constituents of the flue gas, such as carbon monoxide, methone, nitrogen and oxygen fortunately have substantially the same thermal conductivity as air. Water vapor differs somewhat and renders it necessary to provide for compensation to eliminate errors. Temperature of the gases affects both sides of the bridge equally.

THE CLEANING PROBLEM IN OIL STILLS IS TO—

Reduce the cleaning time to a minimum.

Thoroughly remove all of the carbon deposit.

Leave a smooth tube surface that is not injured or damaged in any way.



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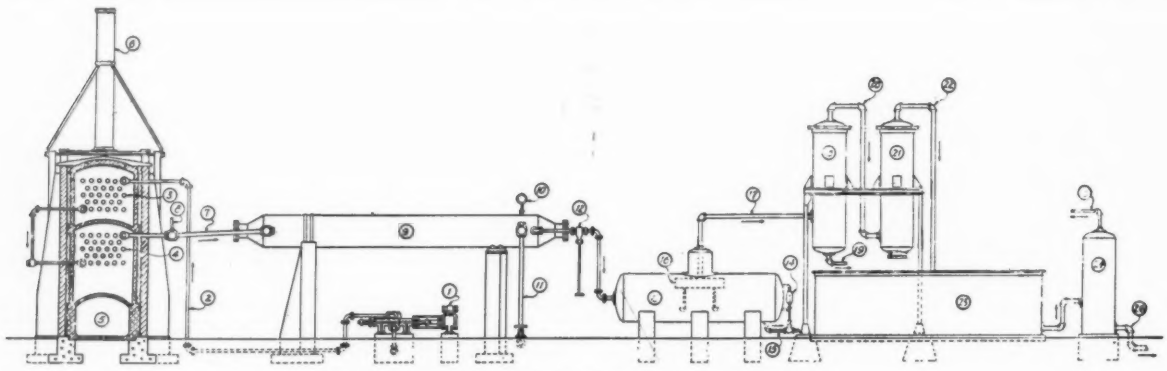


Diagram of Cross Process using vaporizer and towers

Cracking—Or Making Your Oil Pay Dividends

(Continued from page 12)

rugated iron shed is built over the front head of the main drum to house the pyrometers, pressure gauges and gauge glasses. Steel walkways and stairways provide easy access to all operating points.

An eight inch extra heavy O. S. and Y. gate valve, fitted with 1½-inch by pass, is bolted to the still nozzle. The vapor line terminates in a 60-inch diameter by 16 feet high tower which is supported on framing above the condenser bar.

This tower was built by the Kansas City Structural Steel Company and consists of three drums 60 inches in diameter by about 4 feet high each and are connected by two groups of 120 two inch diameter by two feet long tubes.

Vapors from the top section are conveyed through conventional condensing and cooling coils to the receiving house.

These stills are first charged with 150 to 155 barrels of oil which is gradually brought up to the proper temperature and pressure, usually requiring about seven hours. The eight inch valve on the still vapor nozzle is closed during this portion of the operation and the 1½-inch by pass is used to control the pressure within the system. During the next 92 hours raw oil, at an approximate rate of 25 to 30 barrels per hour, is fed into the still. Two hours are then required for pumping out and six hours for steaming and cooling down. The cleaners then enter the drums and clean out the accumulation of carbon. The tubes are cleaned out by means of air driven flue cleaners. This cleaning operation consuming about fourteen hours. Thus the entire operation sums up about as follows: Charge—150-155 barrels.

Feed—25 to 30 barrels per hour (600-720 barrels per day.)	
Fire to over	7 hours
Over to off	92 hours
Pumping out	2 hours
Cooling and Steaming	6 hours
Cleaning and Heading up	14 hours
Charging	2 hours
Total	123 hours

This cycle of 123 hours is an average operation at the American Plant and does not represent a maximum as this depends entirely upon quality of raw feed.

The vapors released through the by pass are conveyed through an eight inch vapor line into the lower chamber of the tower passing upward through a group of tubes into the second section of the tower, then through another group of tubes into the top section of the tower. A heavy cut is removed from the lower section and an intermediate cut from the center section which are re-run in fire stills yielding benzine overhead with gas oil bottom (this gas oil forms a re-cycle stock.) The light cut overhead from the re-run operations is combined with the light cut taken from the upper section of the tower and treated, then steam stilled yielding finished gasoline overhead with kerosene distillate bottoms.

The fixed gas is trapped out of the system in the receiving house and by means of a small blower is forced through a water drum to a gas holder and to burners under the boilers. The water drum serves to clean the gas and remove Hydrogen Sulphides although primarily designed to prevent a flash back through the lines.

The fuel oil, about seven per cent of the charge, containing the carbon is continuously removed from the still from a "quiet zone" at the rear end of the main drum.

Estimated Profits

Assuming 2000 barrels raw gas oil per day.
Units required 5.
Estimated complete cost $275,000
Yield, 30 per cent New navy gasoline.

Costs per 24 hours.

Labor—3 Stillmen @ $6.00, 3 Firemen @ $5.50, 1 Foreman @ $10.00	44.50
Steam—60 H. P. per unit @ 50c	150.00
Water	20.00
Light-Air	10.00
Maintenance & Depreciation 20%	150.70
Cleaning	10.00
Electric Power for drive motors	10.00
Insurance 1%	7.53
Interest 6%	45.18
Taxes, 2% on 50% valuation	7.53
Royalty, 10c per barrel	200.00
Fuel consumed, 3.8% @ $1.16	126.16
Treating and Steam Stilling @ 20c	188.00
Total daily estimated operation	$969.60

Yields

Based on Running Gas Oil once through.

Gasoline 30%—600 bbls. @ $5.67	$3,402.00
Kerosene 15%—300 bbls. @ $2.25	675.00
Gas Oil 30%—600 bbls. @ $1.95	1,170.00
Fuel Oil 20%—400 bbls. @ $1.66	664.00
Loss 5%—100 barrels	
Total, 100%—2000 barrels	$5,911.00

Costs

2000 barrels gas oil @ $1.95	$3,900.00
Operating costs	696.60
Total operation	$4,869.60
Daily net profit	1,041.40

$1,041.40 x 300 days equals $312.420.00 per year.

600 barrels gasoline cost $969.60 or $1.62 per barrel.

(Continued on page 26)

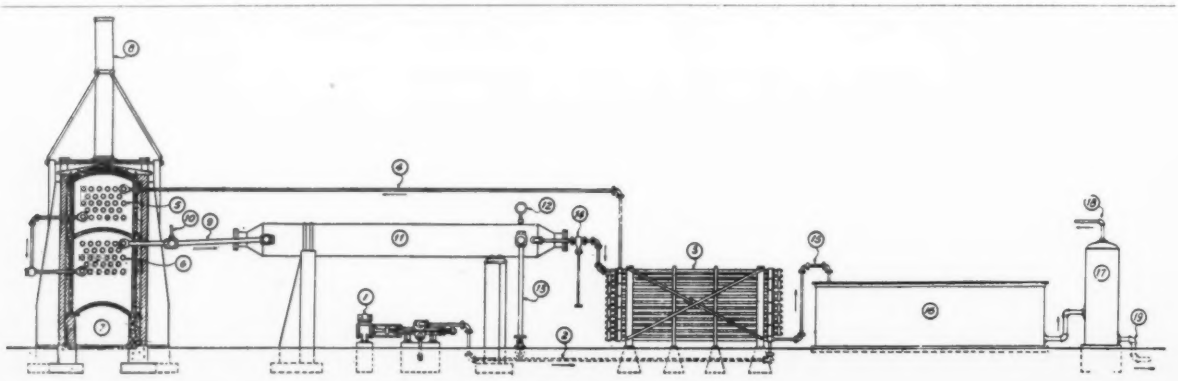
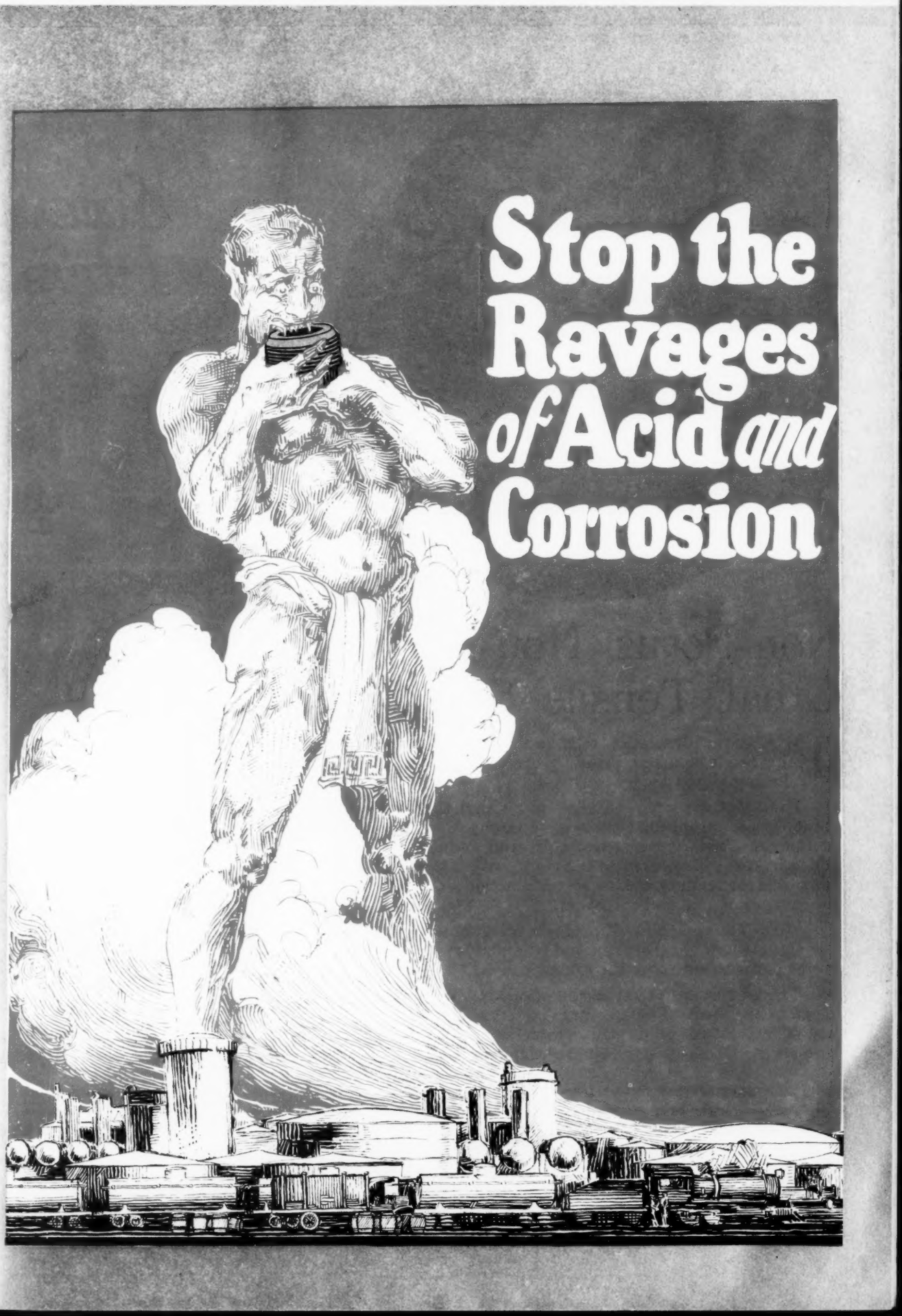


Diagram of Cross Process using Heat Exchanger


Stop the
Ravages
of Acid and
Corrosion

Non-Porus, Non-Pitting, Great Tensile Strength

THE above illustration tells an interesting story. It is the result of a test made by the Armour Institute of Technology, Chicago.

Hills-McCanna No. 45 alloy is a metal that combines great tensile strength, compressive strength, and unusual toughness. This is very desirable, and coupled with the added features illustrated to the right, makes it particularly adaptable for refinery use, and where metals are subjected to the ravages of acid and corrosion.

Hills-McCanna alloy No. 45 is a metal of unusually fine granular structure, non-porus, and non-pitting, which insures products made with this alloy, leakproof.

The co-efficient of expansion of our No. 45 alloy is 50% greater than steel. The advantages of this feature is of particular interest to refinery superintendents using high pressure stills. See back page for still plugs.

Science Te
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HILLS-Mc
NO
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A BRONZE W
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The physical properties, of Hills-
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HILLS-McCANNA CO.

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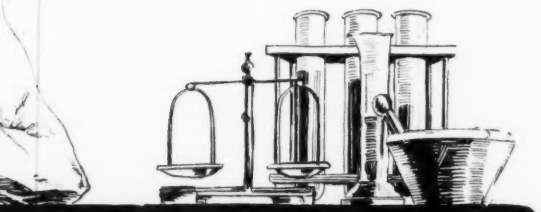


McCANNA
NO.
5

E WITH THE
TH OF STEEL

of Hills-McCanna No. 45 make
ble for use in the oil industry.

Acid Resisting, Non-Corrosive

TESTS of various kinds have been made with Hills-McCanna No. 45 alloy. Of particular interest to refineries is the result of the acid test illustrated above.

Subjected to a 50% sulphuric acid solution for 35 days, Hills-McCanna No. 45 alloy showed a loss in weight of only .032%.

Any parts of your equipment subjected to corrosive agents will give unusually long service when made of Hills-McCanna No. 45 alloy.

We are equipped to make up special designs of any kind in this material, aside from the standard items enumerated on the back page of this circular.

In the event that you are experiencing difficulty due to acid or corrosion, in any part of your equipment, send us drawings or patterns. Stop the ravages of acid and corrosion by using Hills-McCanna No. 45 alloy.

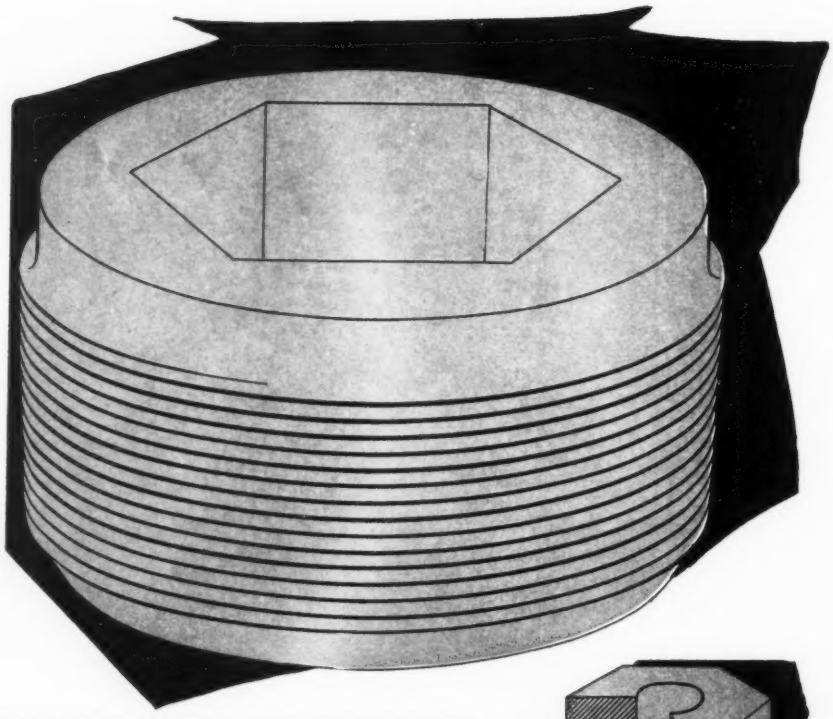
2025 ELSTON AVENUE
CHICAGO

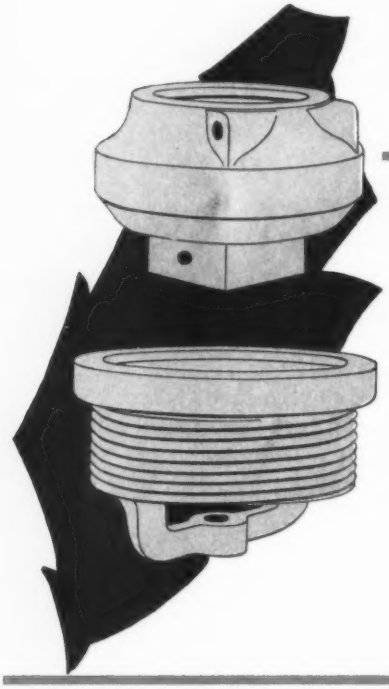
HILLS-McCANNA STILL PLUG

The Hills-McCanna still plug is supplanting all other types of still plugs in this field, and is standard equipment in Dubbs Plants, Sinclair Refining, and many other refineries using pressure stills, or what is known as the "Cracking Process."

This plug, when screwed into the recess, forms a free and comparatively loose-fitting closure, which under heat, expands, making an absolutely tight, leak-proof closure. On cooling down, the plug contracts, making it easily removable, without damaging in any way the header or return bends.

We can supply any type of closure in this metal. Tell us your requirements.





Hills-McCanna Valve Stems and Seats

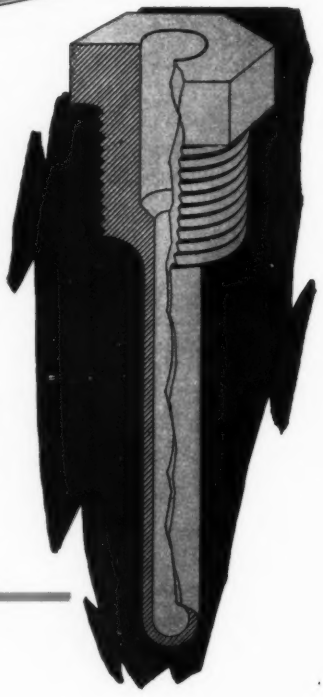
Being made of Hills-McCanna No. 45, our valve stems and seats are non-corrosive, non-pitting, and acid-resisting. They give long continuous service without replacement. Hills McCanna valve stems and seats may be had in any size and shape desired. Send specific information, detailed drawing, or pattern, when ordering.

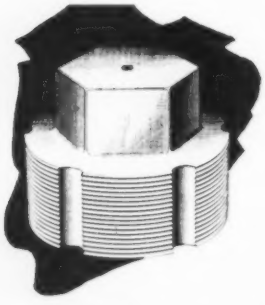
Hills-McCanna Thermometer Wells

The thermal-conductivity of the Hills-McCanna thermometer well is nearly six times greater than the steel well. The result is quick and accurate reading at all times.

Large wells may be made of this material in the single piece, consequently they are more satisfactory than where the well is a built-up unit with several joints.

Made in any size to order. Send detailed information.





Hills-McCanna Clean-Out Plug or Pipe Tap

For cleaning threads in headers or return bends, after the run, the Hills-McCanna clean-out plug is an indispensable tool. It assures a clean thread, and eliminates the danger of damaging the threads when replacing plugs.

The saving of time in replacing closures is so great where this tool is used, that its cost is ridiculously low by comparison. Made of high-grade, hardened tool steel. When ordering state size of plug and thread.

Write Us Your Requirements

If you have any mechanical equipment with parts requiring a non-porous, non-pitting, acid resisting, non-corrosive metal, send us samples to be duplicated with Hills-McCanna No. 45 for test.

HILLS-McCANNA CO.

2025 Elston Avenue
CHICAGO

NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS

Granberg Meter Measures Oil by Gallons And by Gravity—Regular Flow Not Needed

After three years of development and experimental work the Associated Supply Company of Los Angeles is offering the Granberg Meter to refiners and distributors of gasoline and other refined products. This meter will fill a long felt need for some accurate, simple measuring device.

The use of it solves the problem of

how to stop wastage and those losses resulting from careless and inaccurate delivery methods. The Granberg meter gives an absolute check on the amount of deliveries by the employes besides assuring the customer full measurement.

The Granberg meter is made in one, one and a half, two, three and four inch sizes. The purpose of these illustrations, however, is to present the one and a half inch meter which is designed primarily for installation on the rear of trucks delivering gasoline, distillate, kerosene and other refined oils.

From the standpoint of service this type of Granberg meter meets every requirement under actual operating conditions. It measures the flow of the product in gallons by gravity as it is being delivered to the quantity buying customer. It makes no difference how the flow may vary. The last gallon of the load is measured with the same accuracy as the first. It has been demonstrated in continued service of the Granberg meter that the error under varying conditions of discharge is considerably under tolerances allowed by Sealer of Weights and Measures.

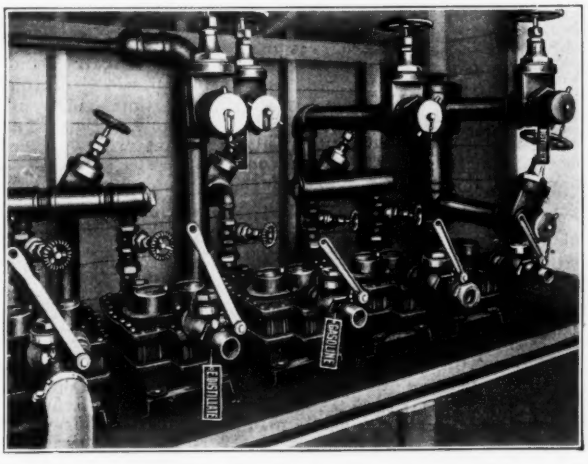
The outstanding features of this device which have appealed to all those associated with its development are its simplicity, absolute accuracy, sturdy construction, and positive adjustment. There are but three moving parts exclusive of the counter. Every drop of liquid passing through the meter is measured by displacement in compartments which are subject to direct and permanent adjustment.

In considering the construction of the Granberg meter, it is well to observe the points that have made it successful:

First: The Granberg meter is absolutely a positive flow meter. There is no by-pass or changing of gear ratios.

Second: The materials which are used in the manufacture of the Granberg meter assure a long life of service. The main castings are made of a special bronze alloy. The valve and guide are of an aluminum alloy. All other parts are die cast or machined from special metals known to withstand the action subjected to. In this connection attention is invited to the fact that parts of the meter of the same pipe size are interchangeable in the event of accidents which necessitate the replacing of damaged or broken parts.

Third: Casting, machine and lathe work on this meter are accomplished by most up-to-date methods with latest improved machinery under supervision of expert workmen.



Fourth: Special methods of inspection before and after the machining of the parts, also during the assembly, provide for the highest degree of perfection. Every Granberg meter is adjustable; is tested and set at the factory before shipment. Any additional adjustment after installation that is found necessary can be easily and quickly made.

The registering mechanism of the Granberg meter consists of two dials and gear train. They are mounted on the top of the meter. One dial contains a totalizing counter moving one digit per gallon of liquid delivered. The other dial has a revolving hand on a graduated plate which makes one revolution per gallon delivered.

Experience of well known oil companies has shown the thorough reliability of the Granberg meter. Its simplicity of design—its sturdy construction—enable it to successfully withstand the terrific shocks encountered by delivery trucks.

Besides being used on delivery trucks the Granberg meter is being used with success on docks for delivery to power boats, also in refineries and distributing stations. What is more, its accuracy, simplicity of adjustment and low maintenance costs make it command the attention of all interested in conserving the oil supply of this country.

The very apparent advantages of the meter have been very enthusiastically endorsed by all oil men who have had occasion to follow through the development stages of the meter, and both foreign and domestic inquiries have been received long before the Associated Supply Company was in a position to offer the finally perfected meter as now being placed on the market.

Colonel Humphreys Has Carbon Plant in Louisiana

Bastrop, La.—The Humphreys Carbon Company, which is headed by Col. A. E. Humphreys of Mexia, Texas, fame, is completing a large carbon black plant in the Monroe gas field, and present plans are to have the plant in full operation before November 1. This plant is expected to manufacture approximately 10,000 pounds of carbon black daily. Headquarters of the company are maintained at Tulsa, with E. I. Newblock actively in charge. The company is owned by Col. Humphreys and his associates.

New York, N. Y.—A course of study designed to acquaint students with the management of oil companies has been added to the curriculum of the New York University.

The REFINER will print on this page data on new refinery equipment, improvements on old equipment, news of new catalogs, bulletins, etc. This department is handled exclusively by the editorial department and has no connection with the advertising department. Data will be carried on anything which the editorial department thinks of interest to our readers, regardless of whether or not the manufacturer is an advertiser.—Publisher.

PERSONNEL OF THE INDUSTRY

HOWARD BENNETTE

Recently appointed secretary of the Western Petroleum Refiners Association

L. M. Bounds, superintendent of the Okmulgee, Oklahoma, refinery of Empire Refineries, Inc., recently addressed members of the Okmulgee district Oil and Gas Association on the subject of "What Becomes of the Crude After the Refinery Gets It."

Frederick D. Asche, vice president of the Standard Oil Company (New Jersey) was among the passengers on the liner Majestic that cleared from New York the latter part of September for Europe.

F. W. Burford, who has been in Pittsburgh in connection with sales of the Skelly Oil Company, has reurned to the company's general offices in Tulsa, Oklahoma.

R. K. Blanchard, manager of the oil and gas department of the Neptune Meter Company, New York City, is in Tulsa, Oklahoma, on business.

S. A. McCune, superintendent of the gas division of the Empire Companies of Bartlesville, Oklahoma, has resigned effective September 10.

P. J. Crowley of the Chicago offices of the Union Petroleum Company was in Tulsa the latter part of September on a tour of the Mid-Continent refining field.

T. F. Thompson has been appointed manager of the Chicago offices of the Tidal Refining Company with general offices in Tulsa, Oklahoma.

After an extended sojourn in the Great Lakes region which included a visit in Chicago, Geo. F. Brigham, president of the Commerce Petrolcum Company and Tulsa district manager of the North American Car Company, has returned to the Mid-Continent.

A motor and lubricating oil department in charge of P. W. Wilkins has been established in Chicago by the Moore Refining Company with refinery at Arkansas City, Kansas.

L. M. Fanning, statistician of the American Petroleum Institute, is away from his New York headquarters on a trip through the Mid-Continent field.

J. L. Green, who has been assistant manager of the Arkansas division of the Magnolia Petroleum Company, has been transferred to Oklahoma in a similar capacity.

F. H. Kay of the Sun Oil Company with headquarters at Caracas, Venezuela, South America, has been on an extended trip in the United States, visiting in the Mid-Continent and other fields after coming to Philadelphia.

Announcement is made from the company's office in St. Louis that W. O. Schock has not resigned his position with the Indiahoma Refining Company, press reports to the contrary notwithstanding. D. E. Schock has resigned from the company.

F. G. Palmer, president of the Kaw Boiler Works Company of Kansas City, Kansas, was in Tulsa last month in connection with the opening of a branch office of his company there. Temporary offices are located in room 235, Oklahoma hotel.

"Bill" Campbell, who is sales manager of the Panhandle Refining Company with headquarters at Dallas during most of the year, is in California having a good time. He thinks Dallas is "some" town, but words fail him when he starts to talking about Los Angeles. In fact he has privately made the promise that he will ask for a longer vacation next year—and strike for Los Angeles within an hour after his 1924 vacation starts. Of course he called at the Los Angeles office of The OIL WEEKLY for a late copy to see what was going on all over the United States and in foreign oil circles.

A. V. Farr of the Calorizing Company of New York City, is in Tulsa, Oklahoma, attending the convention.

D. W. Salisbury of the Southwestern Engineering Company of New York City, is visiting refiners in the Southwestern states.

E. F. Blaise of the Inland Refining Company has returned to Oklahoma after a tour of the West Coast country, including a visit to the California fields.

F. E. Powell, chairman of Anglo-American Oil Company, has arrived in the United States from England for an annual business trip in this country.

M. C. Linn, office manager of the National Refining Company in Oklahoma City, Oklahoma, for several years, has been promoted to the position of state manager. V. R. Wittich has been appointed assistant state manager with offices in Tulsa.

Joseph Taylor, foreman of the wax plant at the Moore Refining Company's plant here, and four other refinery employes are dead as a result of an explosion October 2 on the refinery grounds.

C. E. Steidel, who has been connected with the Bureau of Mines at Washington, assisting in the compilation of refinery statistics in the United States, has recently been transferred to the San Francisco office of the Bureau of Mines to gather and compile refinery statistics in California. E. C. Lane, for some time had been doing this work, but now will give his full time to chemical research work.

C. M. Davidson has been appointed general superintendent of gasoline plant operations of the Empire Gas and Fuel Company. I. P. Parkhurst will continue as superintendent of casinghead gas tests, contracts and settlements. J. K. Richardson becomes superintendent of construction and S. B. Crooks is office engineer.

F. E. McMahon, director of sales of the Sapulpa Refining Company, has returned to Chicago after a visit to the company's offices in Oklahoma.

J. H. Welch of the Tidal Refining Company of Tulsa, Oklahoma, was in Washington the first part of August in connection with a hearing on gas royalties before Indian Commissioner Burke.

The Reeves Vertical Gas Engine-Compressors for Gas Booster Plants

A few of the reasons why leading companies and engineers are purchasing the Reeves Gas Engines and Compressors.

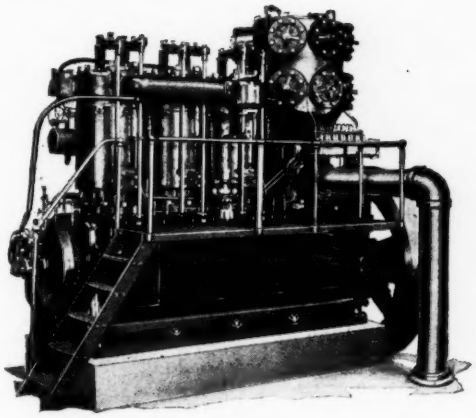
They know the Reeves unit is not an experiment, having proven its reliability and worth over a period of about twenty years successful service.

Account of the simplicity of operation; low fuel and maintenance cost per horse power. One user just reported having operated last four units 16 months without shutdown.

All Compressors equipped with "Hope" Biplane, Patented, easy operating, high speed Valves.

Saving in installation time partly pays for unit.

Saving in plant construction cost from 20 to 50 per cent depending on location.



Engine Sizes:
40 H. P. up to 250 H. P.

Engine-Compressor Sizes:
60 H. P. up to 160 H. P.

Consulting and Contracting Engineers in Natural Gas and Oil.

HOPE ENGINEERING & SUPPLY CO.
Mt. Vernon, Ohio, U.S.A.

Branches
Pittsburgh, Penna.
Tulsa, Okla.
Casper, Wyo.

Attend the—

International Petroleum Exposition

Tulsa, Oklahoma

October 8th to 14th

Our representatives will be there. Service and quick delivery are the keynotes of our business.

Storage Tanks	Acid Tanks
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Condenser Boxes	Vapor Towers

Heat Exchangers	Loading Racks
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Tell them where you saw the ad

RECENT REFINERY PATENTS ISSUED

BY STAFF REPRESENTATIVE

Washington, D. C.—The following patents of interest to the oil refining industry have recently been issued by the United States Patent Office at Washington:

No. 1,467,757, issued on September 11 to David T. Day, Washington, D. C., on a process and apparatus for the extraction of hydrocarbon oils from shale. The process consists in subjecting a mass of fresh untreated shale in a closed chamber located outside of a furnace and removed from the action of the heating medium thereof to the action of hot acriform material constituting the sole heating medium for said chamber and composed solely of vapors and gases driven off from similar shale to distill off volatile material from said fresh shale in the closed chamber, and subjecting similar shale material to the action of heat applied to the exterior of a retort within a furnace to drive off hydrocarbon vapors and gases in acriform condition, conducting said acriform material into said chamber through an opening in the lower part of said chamber and releasing it into the mass of shale therein, and leading acriform material from the upper part of said chamber, the chamber and the shale within it being altogether removed from the heating action of the furnace gases of combustion and the sole source of heat for said chamber being from within and provided by gases from said retort.

No. 1,467,758, issued on September 11 to David T. Day on a process of producing hydrocarbon materials. It covers the process of converting hydrocarbon oils having high boiling points to hydrocarbon oils having low boiling points and preventing carbon depositions on the interior of the treatment apparatus, which process comprises adding the oil to be treated to a mass of hydrocarbon oil-bearing shale adapted to form with the non-volatile residuum of the oil a dry non-caking mixture, continuously introducing the shale with the added oil into a retort, subjecting said material while in said retort to cracking temperatures, utiiizing the shale while within said retort as a scouring medium for keeping the interior of the retort free from deposits, continuously passing said material so treated from said retort, and condensing the low boiling point oils thus driven off.

No. 1,467,831, issued on September 11 to William S. Barnickel, of St. Louis, Mo., on a process for treating petroleum emulsions. The patent covers, in the art of treating roily oil and bottom settlings, the process which comprises thoroughly commingling a sulfo fatty acid with the oil to be treated, thereby freeing the globules of water from the oil, and then permitting the relatively heavy substances in the oil to drop to the bottom of the mass, whereby the oil is separated from the water and impurities.

No. 1,468,353, issued on September 18 to Charles M. Bullard, of Appleton, Wis., on a method of treating a liquid in a container consisting in forming a stream of liquid in circuit with the container, passing the stream of liquid through a heating element to heat the liquid in the stream, and mechanically violently agitating the liquid while the liquid is in direct contact with the heating element.

No. 1,468,435, issued on September 18 to John Zander, Chicago, Ill., on a distillation apparatus. The patent covers a still comprising a chamber having floor sections arranged one above the other in spaced relation with an opening from the upper floor to the floor below it, said furnace having a liquid-seal inlet toward the end of the upper floor opposite that containing said opening, and a liquid-seal outlet toward the end of the lower floor opposite that adjacent said opening, means for heating the material, and means operating through said liquid-seals for moving the material from said inlet along said floor sections and through said inlet.

No. 1,469,426, issued on October 2 to James Roys Miller, Pittsburgh, Pa., on a process for reclaiming used oil. It is a process of reclaiming waste lubricating oil from gasoline engines which consists of heating the oil, injecting steam into the oil whereby the particles of oil are separated and the volatile matter is driven off, adding a soap solution to the oil and injecting steam whereby the dirt and foreign matter is coagulated maintaining the temperature to expel water, and separating the solids from the oil.

No. 1,469,628, issued on October 2 to Roy C. Dundas, Los Angeles, and Raymond T. Howes, Santa Maria, Calif., assignors to S. E. Company, a corporation of Delaware. The patent covers a method of distilling oil shale or the like, which consists in slowly and progressively burning a charge of shale in a closed chamber from the top downwardly, maintaining the combustion at a substantially constant temperature by supplying and regulating a downward current of air through the chamber, and drawing off the hydrocarbon products at the bottom of the chamber.

Wichita Falls, Texas.—Fire caused by the breaking of a flow line leading into a condensor box at the Primrose Refining Company's refinery near Wichita Falls resulted in a small amount of damage early this month.

Natural Gasoline Men May Meet in Dallas in November

Tulsa, Okla.—A. V. Bourque of Tulsa, secretary of the Association of Natural Gasoline Manufacturers, has announced that the annual winter conference of the organization will probably be held in Dallas, Texas, some time in November.

The winter conference of 1922 was held in St. Louis.

Humble Has New Cracking Unit in at Burk Plant

Burkburnett, Texas.—A single unit of the Standard Development Company's new cracking process has been installed by the Humble Oil & Refining Company at its refinery located near Burkburnett. The cracking process is known as the tank and tube system, and has a daily capacity of 1000 barrels. It has been placed in operation, and the results obtained are reported to have been most satisfactory.

Established 1867

The Vilter Manufacturing Co.

1152-1162 CLINTON ST., MILWAUKEE, WIS.

Vilter High Speed Horizontal Refrigerating Machine

Builders of Refrigerating Machinery, Oil Cooling Coils, Gasoline Condensers, Etc.

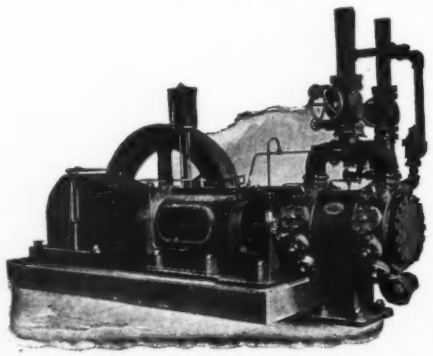
Vilter Equipment is used in many of the oil refineries.

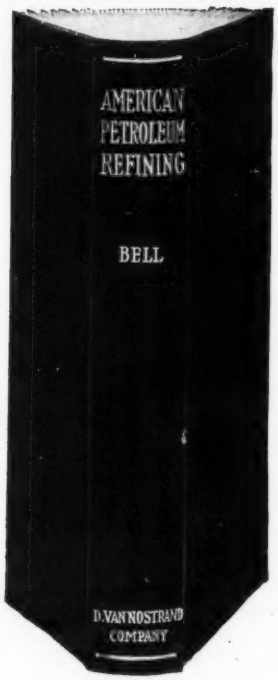
Vilter-Milwaukee typifies the true standard of reliability in machinery construction and refrigerating engineering.

Vilter Low Temperature Compression System (for efficiently producing low temperatures with compression system.)

Vilter Sales Engineers always at your service.

Branch offices in all the principal cities.





AMERICAN PETROLEUM REFINING

By

H. S. BELL, C. E.

Member, American Petroleum Institute; Associate Member, American Society of Civil Engineers; Associate Member, American Society of Mechanical Engineers

A complete analysis of the problem of petroleum refining, giving reliable up to date information on every phase of modern American practice.

"American Petroleum Refining" has been issued to meet the need for a book devoted to the refining of petroleum, a demand that has been apparent for a long time.

It is a critical examination of every phase of American petroleum refining, stressing the design and operation of refineries and presenting much of its material in tabular form. These tables are based on actual experience gained from the careful investigation and intimate contact with many of our most important oil refineries and they reflect the latest and most improved practice. Special chapters on the physical and chemical properties of petroleum and its products have been contributed by eminent authorities.

Every item in the book is intended to contain definite, usable and wanted information and all extraneous material that can be found in the standard engineering handbooks of the day has been purposely omitted.

Little attention has heretofore been directed at efficient plant operation and this book is designed to guide and instruct plant superintendents who appreciate the importance and necessity of efficiency. An oil refinery, for example, presents a fertile field for work along heat conservation lines and Mr. Bell includes much data gained from actual experience together with their applications to every day problems.

Employes or heads of refineries or oil companies who are in charge of or are planning extensions or modifications to their plants falling outside the scope of their own experience, will find in it the necessary technical data. Supply Houses also will find this book of great interest as its discussion of the machinery and material in common use in refineries is unusually thorough and complete.

Condensed Table of Contents:

General Introductory.
Crude Oils and Their Characteristics.
Chemical Properties of Petroleum.
Physical Properties of Petroleum and its Products.
The Manufacturing Process.
The Refinery Site and General Arrangement.
Stills.
Condensers.
Heat Exchangers.
Cracking.
Chemical Treatment.
Wax Plants.
Filtering.
Cold Settling.
Compounding
Storage of Oil.
Volume Measurements.
Bulk Transportation.
Packages.
The Power Plant and Boiler House.
Acid Recovery.
General Departments.
Fire Protection.

475 Pages 6 x 9 263 Illustrations Postpaid $5.00

FOR SALE BY

Gulf Publishing Company

P. O. Box 1307 Houston, Texas

Cracking—Or Making Your Oil Pay Dividends

(Continued from page 20)

The Coast Stills are rated at 150 to 160 barrels of gas oil per day. The Still consists of a horizontal steel shell 8 feet in diameter by 40 feet in length set within common brick settings. The fire sheet is kept free of carbon by a rocker arm movement which drags a series of chains across the bottom of the still thus keeping the carbon in suspension. Vapors are conveyed through three shell and tube type aerial condensers or horizontal reflux towers to the control house where the pressure is released and vapors condensed at atmospheric pressure.

The initial charge of the still is 250 barrels of gas oil which is raised to an operating temperature of 750 degrees F. Pressure within the still is raised to 80 pounds per square inch.

As vapors pass through the towers 90 per cent is condensed and refluxed back into the still to be cracked further. Uncondensed vapors are released from pressure in the receiving house by means of a valve, after which they pass into the condenser.

Pressure in the still is shown by a gauge at the pressure relief valve in the receiving house. A thermometer at the same point shows temperature of the still. Regulating of the pressure is accomplished by increasing or decreasing the flow of still vapors through the pressure relief valve to the condenser box.

After leaving the condenser the pressure benzine passes through a gas and water separator and then through a meter where the amount is carefully checked. Another meter in the receiving house records the amount of gas oil being pumped into the still through the preheater and the two meters are synchronized so that the level of fluid in the still will not vary in height.

The gas oil pumped through the preheater is raised to between 300 and 350 degrees before it reaches the still. This effects a considerable saving in fuel as well as reducing strains on the still which would be caused by one introduction of cold liquid.

During the cycle 150 barrels of gas oil are pumped into the still which brings the total oil treated to 400 barrels. The cycle is 60 hours making the still capacity approximately 160 barrels per day of 24 hours. The 60 hour cycle consists of: 52 hours running time, 7¼ hours charging, cooling and steaming, and ½ hour cleaning.

Of the gas oil charged, approximately 70 per cent goes over as pressure distillate during the cycle, 26 per cent remains as fuel oil and the still loss is arount 4 per cent. Treatment of the pressure distillate before steam stilling causes a loss of 2 per cent of the distillate.

It is claimed that based on actual operations over a considerable period the distillate yields 61.2 per cent gasoline, 7.2 per cent kerosene, 30.6 per cent fuel oil and a loss of .9 per cent which figured back on gas oil charged shows:

40 per cent 56 Be. 437 E. P. Gasoline.
7 per cent 42 Be. Water White Kerosene.
47 per cent 22 Be. Fuel Oil.
6 per cent Loss.

Yields as given are those obtained from the first cycle on gas oil.

Average fuel consumption is given as 9 per cent of the total chage to the still.

The process is being offered for sale and installed exclusively by the F. W. Freeborn Engineering Corporation which has offices in Tulsa, Dallas, St. Louis, New York and Boston. The royalty charged is ½ cent per gallon on gasoline produced.

Estimated Profits

Assuming 2000 barrels raw gas oil per day.
Units required, 14.
Estimated complete cost $500,000.00
Yield 40 per cent New navy gasoline.
Costs per 24 hours.
Labor—3 stillmen at $6.00, 3 housemen at $5.00, firemen at $5.50, 1 superintendent at $10.00 .....$76.00
Steam 200 B H P at 50c.....100.00
Water 50.00
Light-Air, etc. 20.00
Maintenance & Depreciation, 20% ..273.90
Cleaning $10.00 per still each 60 hours 56.00
Insurance 1% 13.70
Interest 6% 82.20
Taxes 20% on 50% valuation..... 13.70
Royalty ½ cent per gal. on gasoline.168.00
Fuel consumed, 10% at $1.66.....$332.00
Treating and steam stilling at 25c.. 350.00
Total daily estimated operations.$1,535.50

Yields

Gasoline 40%—800 barrels @ $5.67...$4,536.00
Kerosene 7%—140 barrels @ $2.10 ... 294.00
Fuel Oil 47%—940 barrels @ $1.66.. 1,560.00
Loss 6%—120 barrels.

Total, 100%—2000 barrels $6,390.40

Costs

2000 barrels Gas Oil @ 1.95.....$3,900.00
Estimated operations 1,535.50

Total $5,435.50
Gross Revenue $6,390.40
Operation 5,435.50

Net Daily Revenue .....$ 954.90

$954.90 x 300 days equals $286,470.00 per year.

800 barrels gasoline cost $1,535.50 or $1.91 per barrel.

(Continued on page 36)

Lease Tank Cars—And Save Money

Shippers—large and small—find it advantageous to lease North American Tank Cars instead of purchasing their own because:

1. Demand for rolling stock fluctuates, Cars can be leased as needed and equipment does not stand idle at shipper's expense. Deliveries are improved at a saving.

2. Shippers are relieved of the responsibility and expense of upkeep. N. A. T. X. ALWAYS REPORT IN A1 CONDITION because of frequent, rigid inspections at our three expert repair shops.

3. Leasing relieves lessee of a heavy capital investment yet gives him cars especially suited to his product.

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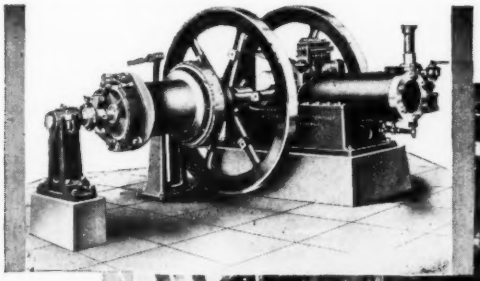
Coffeyville, Kans.
West Tulsa, Okla.

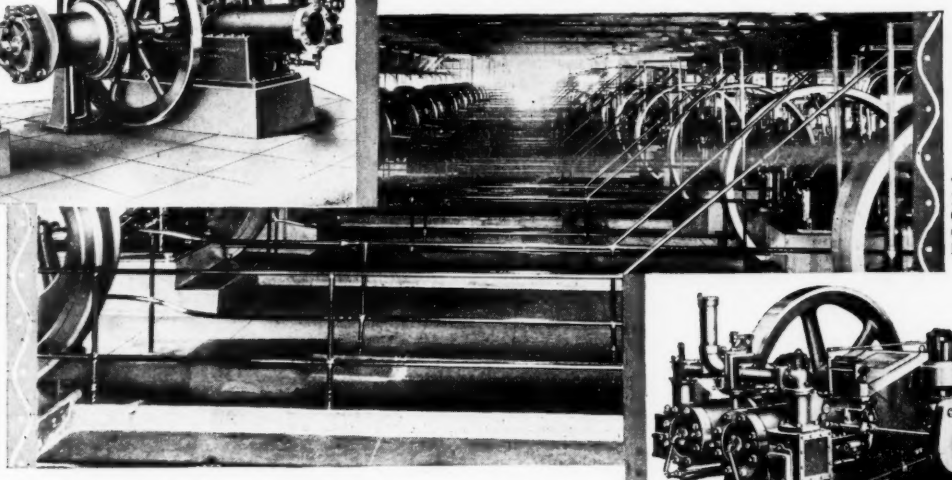
Southwestern District Office
Petroleum Bldg.
Tulsa

Lessors Of Tank Cars

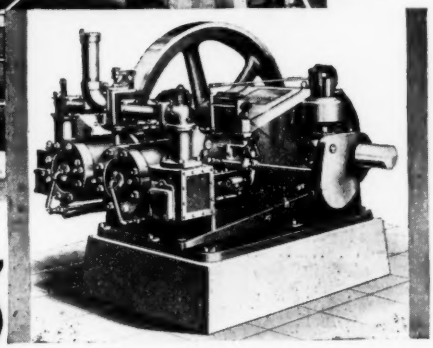


"Western" Oil Field Engine & Reverse Gear Catalog No. 300

16-160 H. P. "Western" Duplex Gas Engines in Gasoline Compression service. One of 12 plants owned by one company using "Western" engines exclusively.



"Western" Duplex Gas Engine Catalog No. 400



THERE ARE REASONS For This Standardizing on WESTERN

Not every company operating in the petroleum industry has standardized on "Western" Engines, to be sure, for the opportunity of knowing just how good these engines are, and of testing them out, has not always been immediately available to all of them.

Where these opportunities have existed, you will find many companies having plants of various sizes where "Western" Engines are the standardized power equipment in use.

And invariably, this standardization of "Western" Engines has taken place as a result of tests of a single "Western" in competition with other equipment which at the time was considered very satisfactory.

When a single engine can change the entire power policy of a long established company, as a "Western" Engine frequently has, there are very good reasons for the change.

These reasons consist of high efficiency; economy in operation and upkeep; extraordinary dependability; correct design; and rugged construction which enables them to withstand the hardest service.

"Western" Gas Engines for oil country service are in a class by themselves. They are acknowledged superior in efficiency, economy and dependability by all who absolutely know power equipment, and accepted as the one outstanding success in gas engine design, construction and performance among all similar equipment.

Definite and detailed records of performance will be furnished on request to anyone interested, without obligation.

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Mid-Continent Refinery Operations

AS OF OCTOBER 1, 1923

ARKANSAS

Plant and Location—	Capacity	Now Running
Abner Davis, El Dorado	60	SD
Airedale Ref. Co., El Dorado	1,000	SD
Arkansas Ref. Co., Ft. Smith	1,000	SD
Ark Prod. & Ref. Co., El Dorado	1,000	450
El Dorado P L. & Ref. Co., El Dorado	2,000	SD
Farmer Oil & Ref. Co., Texarkana	1,000	250
Four States Ref. Co., Texarkana	400	SD
Grison Ref. Co., El Dorado	750	SD
Jones Bros. & Tatum, El Dorado	1,000	500
Kettle Creek Ref. Co., Pearson	2,000	1,400
Lion Oil & Ref. Co., El Dorado	12,000	7,200
Newark Ref. Co., El Dorado	1,500	400
Pine Bluff Ref. Co., Pine Bluff	1,500	900
Root Refineries, El Dorado	3,000	2,000
Shippers Pet. Co., El Dorado	1,800	600
The Arkansas Ref. Co., Picron	3,000	SD
Union P. L. & Ref. Co., El Dorado	4,000	700
Total for Arkansas	36,960	14,200

KANSAS

Plant and Location—	Capacity	Now Running
Associated Prod. & Ref. Co., El Dorado	1,000	SD
Bell Prod. & Ref. Co., Wichita	700	SD
Commonwealth Oil & Ref. Co., Moran	800	200
Derby Oil & Ref. Co., Wichita	5,000	SD
Chemical O. & G. Co., Oswatomie	1,000	SD
El Dorado Ref. Co., El Dorado	4,000	1,800
Frontier Ref. Co., Hutchison	2,000	SD
Golden Rule Ref. Co., Wichita	800	600
Grant Oil Co., Augusta	2,500	700
Great Western Pet. Co., Florence	2,000	SD
Great Western Ref. Co., Erie	1,500	SD
Industrial Ref. Co., El Dorado	1,500	SD
Kanotex Ref. Co., Arkansas City	3,000	1,500
Kansas City Ref. Co., Kansas City	5,000	2,300
Kansas Oil Ref. Co., Coffeyville	2,000	400
Kansas Tex. Oil Ref. Co., Wichita	1,500	SD
Interstate Refineries Inc., Centropolis	1,000	SD
Lesh Ref. Co., Arkansas City	1,500	400
Midland Ref. Co., El Dorado	12,000	10,000
Mutual Oil Co., Chanute	1,500	SD
Mecca Ref. Co., Augusta	2,500	SD
Marshal & Co., Sheffield	2,500	SD
Moore Ref. Co., Arkansas City	4,500	2,000
McCree Pet. Co., Baxter Springs	600	SD
McWhorter-Chanute Ref. Co., Chanute	200	SD
Miller Pet. Co., Humbolt	1,500	SD
National Ref. Co., Coffeyville	5,000	4,600
North Amer. Ref. Co., Rosedale	700	SD
Peerless Oil & Ref. Co., Chanute	3,000	3,000
Richardson Ref. Co., El Dorado	2,000	300
Red Bird Ref. Co., Fredonia	800	400
Sinclair Ref. Co., Argentine	6,000	SD
Sinclair Ref. Co., Coffeyville	7,000	2,200
Sterline Oil & Ref. Co., Wichita	5,000	2,200
Standard Oil Co. (Kansas) Neodesha	12,000	SD
Uncle Sam Oil Co., Argentine	700	SD
Uncle Sam Oil Co., Cherryvale	2,400	SD
Vickers Pet. Co., Potwin	1,800	700
White Eagle Oil & Ref. Co., Augusta	6,000	6,600
Total for Kansas	114,700	40,300

LOUISIANA

Plant and Location—	Capacity	Now Running
Caddo Central O. & R. Co., Shreveport	3,500	SD
Caddo Central O. & R. Co. Shreveport	7,000	4,500
International O. & G. Co., Cedar Grove	800	SD
Homer Ref. Co., Homer	250	SD
Leeton Ref. Co., Shreveport	1,000	SD
Louisiana Pet. Prod. Co., Bossier	6,000	1,500
Louisiana Oil & Ref. Co., Shreveport	6,000	5,000
Red River Ref. Co., Crichton	1,500	SD
Paramount Pet. Co., Superior	3,000	SD
Rogers Ref. Co., Shreveport	1,500	SD
Shreveport Oil & Ref. Co., Shreveport	4,500	4,250
Tar Island Ref. Co., Mooringsport	300	SD
The Texas Co., Arlda	5,000	†4,250
Union Ref. & P. L. Co., Oil City	1,000	SD
Union Ref. & P. L. Co., Homer	1000	SD
Total for Louisiana	48,650	19,500

MISSOURI

Plant and Location—	Capacity	Now Running
Wilhoit Ref. Co., Joplin	2,000	700

OKLAHOMA

Plant and Location—	Capacity	Now Running
Acme Ref. Co., & P. L. Co., Jennings	2,600	SD
Allied Ref. Co., Okmulgee	2,000	400
Anderson & Prichard Oil Corp., Oklahoma City	1,200	800
Associated P. & R. Co., Yale	1,000	SD
Barnsdall Ref. Co., Barnsdall	3,000	2,300
Bay State Ref. Co., Healdton	1,000	SD
Beaver P. & R. Co., Dilworth	700	SD
Big Six Ref. Co., Sapulpa	3,000	SD
Bison Ref. Co., Quay	1,000	SD
Blue Ribbon Ref. Co., Walters	500	SD
Bolene Ref. Co., Enid	3,600	2,200
Bristow Gasoline & Sup. Co., Bristow	400	SD
Buffalo-Ref. Co., Yale	1,000	SD
Cushing Ref. Co., Cushing	1,000	1,600
Cameron Ref. Co., Ardmore	3,500	2,500
Canfield Ref. Co., Yale	500	100
Carter Oil Co., Cartoco	12,000	SD
Champlin Ref. Co., Oilton	1,000	SD
Chesnat & Smith Corp., Sand Springs	5,000	SD
Choate Oil Corp., Okla. City	2,000	SD
Coleman-Nelson Corp., West Tulsa	2,000	SD
Coleman-Nelson Corp., Haskell	1,000	SD
Constantine Ref. Co., Devol	10,000	SD
Constantine Ref. Co., West Tulsa	4,500	S D
Cosden & Co., West Tulsa	35,000	19,000
Cushing Ref. & Gasoline Co. Blackwell	1,000	300
Daisy Bell Pet. Co., Wilson	2,000	400
Damascus Ref. Co., Lawton	1,500	SD
El Dorado Ref. Co., Yale	700	SD
Equality Ref. Co., Oilton	1,000	SD
Empire Refineries Inc., Cushing	5,000	3,500
Empire Refineries Inc., Okmulgee	2,500	2,200
Empire Refineries Inc., Oklahoma City	2,500	SD
Empire Refineries Inc., Ponca City	4,500	3,400
Francis Ref. Co., Francis	5,000	SD
Frederick Ref. Co., Frederick	5,000	SD
Fairmont Ref. Co., Fairmont	2,500	SD
Federal Oil & Ref. Co., Cushing	1,500	SD
Globe Oil & Ref. Co. Blackwell	4,000	1,600
Gilmer Oil Co., Ringling	8,000	200
Golden Belt Ref. Co., Okla. City	200	SD
Grandfield Oil & Ref. Co., Grandfield	3,000	1,600
Great American Ref. Co., Jennings	2,500	*
Hewitt Ref.Co., Hewitt	1,600	1,200
Home Oil & Ref. Co., Yale	2,000	SD
Indian Chief Ref. Co., Cushing	1,800	SD
Lorraine Pet. Co., Bristow	2,500	1,500
Imperial Ref. Co., Ardmore	6,000	6,000
Indiahoma Ref. Co., Okmulgee	9,000	SD
Illinois Oil Co., Cushing	3,000	2,100
Inland Ref. Co., Cushing	3,000	SD
Johnson Oil Ref. Co., Cleveland	2,500	2,400
Lawton Ref. Co., Lawton	1,100	SD
Livingston Ref. Corp., Walters	3,000	*
Local Ref. Co., Okla. City	1,000	600
Marland Ref. Co., Ponca City	12,000	6,000
Marland Ref. Co., Covington	1,000	350
Maud Oil & Ref. Co.	400	100
Mecca Ref. Co., Allen	1,500	550
Meridian Ref. Co., Okmulgee	3,000	SD
Meridian Ref. Co., Hominy	1,000	SD
Meridian Ref. Co., Ponca City	2,500	SD
Mid-Co Pet. Co., West Tulsa	7,000	SD
Navajo Ref. Co., Sapulpa	1,500	700
North American Ref. Co., Pemeta	1,500	SD
Nyanza Ref. Co., Wilson	3,500	700
Oil State Ref. Co., Enid	2,500	550
Pontotoc P. L. & R. Co., Allen	600	250
Omar Ref. Co., Garber	2,500	650
Okla. Prod. & Ref. Co., Muskogee	2,500	SD
Pawhuska Ref. Co., Pawhuska	1,000	SD
Waite Phillips Co., Okmulgee	4,000	4,050
Pierce Oil Corp., Sand Springs	9,000	5,000
Prod. & Ref. Corp., Blackwell	2,500	2,000
Prod. & Ref. Corp., West Tulsa	6,000	4,200
Pure Oil Co., Ardmore	7,000	3,700
Pure Oil Co., Cushing	6,500	3,400
Pauline Ref. Co., Hampton	1,200	600
Powerine Oil Co., Billings	500	SD
Pioneer Pet. Co., Guthrie	2,500	SD
Sheridan Ref. Co., Newkirk	2,000	SD
Rock Island Ref. & P. L. Co., Duncan	1,200	1,000
Santa Fe Oil & Ref. Co., Ardmore	3,000	SD
Shaffer Oil & Ref. Co., Cushing	6,500	3,800
Sapulpa Ref. Co., Sapulpa	7,000	2,200
Southern Oil Corp., Yale	6,000	SD
Southern Oil Corp., Walter	2,500	SD
Sun Company, Yale	4,500	2,300
Southwestern Oil Corp., Enid	1,800	SD
Sinclair Ref. Co., Cushing	5.500	†
Sinclair Ref. Co., Muskogee	2,000	450
Sagimore Oil Corp., Grandfield	2,000	1,850
Texas Company, West Tulsa	8,000	5,500
Texas-Pacific Coal & Oil Co., Wynnewood	5,000	2,500
Tidal Ref. Co., Drumwright	4,500	4,500
Tonkawa Pet. Co., Tonkawa	1,500	500
Travis Senter Ref. Co., Comanche	1,500	800
Transcontinental Oil Co., Boynon	2,500	1,700
Transcontinental Oil Co., Bristow	5,000	4,500
Turley Ref. Co., Oklahoma City	2,500	400
Union Oil & Ref. Co., Grandfield	2,000	1,800
Wagoner Ref. Co., Wagoner	500	SD
Wilcox Ref. Co., Bristow	500	400
Yale Oil Corporation, Yale	1,200	800
Oklahoma total	357,300	115,900

TEXAS

Plant and Location—	Capacity	Now Running
American Oil Corp., Pioneer	2,500	200
American Ref. Co., Wichita Falls	5,000	4,800
H. E. Boner, Burkburnett	700	400
The Petroleum Corp., Electra	2,000	1,000
Buffalo Ref. Co., Sherman	500	200
Burk-Texas Ref. Co., Burkburnett	1,200	SD
Bear Ref. Co., Burkburnett	1,200	SD
Clayton Oil & Ref. Co., Dallas	3,500	1,700
Crystal Pet. Co., Burkburnett	1,000	SD
Eastland-Pioneer Oil & Ref. Co., Cisco	1,000	SD
Empire Refineries, Inc., Gainsville	7,000	2,900
General Refineries, Inc., Abilene	1,500	SD
Gulf Ref. Co., Fort Worth	15,000	5,000
Gorman Ref. Co., Gorman	1,000	SD
Griswold Ref. Co., Electra	2,000	1,700
Humble O. & R. Co., Burkburnett	1.500	1,000
Invincible Oil Corp., Fort Worth	6,000	SD
Interstate Gasoline Co., Iowa Park	2,000	200
Iowa Park Prod. & Ref. Co., Iowa Park	1,000	500
Keystone Ranger Ref. Co., Wichita Falls	2,000	SD
Lone Star Ref. Co., Wichita Falls	4,000	SD
Manhattan Pet. Prod. Co., Wichita Falls	2,500	SD
Megargel Oil & Ref. Co., Megargel	500	§
Miller Pet. Co., Wichita Falls	2,500	2,000
Mexia Oil & Ref. Co., Mexia	600	200
Magnolia Pet. Co., Fort Worth	12,500	5,500
Noble Oil & Gas Co., Burkburnett	5,000	1,900
Nortex Ref. Co., Burkburnett	2,000	SD
North Texas Ref. Co., Greenville	1,000	SD
Owenwood Oil Corp., Burkburnett	2,000	SD
Oriental Ref. Co., Dallas	5,000	400
Oddessa Ref. Co., Ranger	1,000	†
Orient Pet. Co., Wichita Falls	2,000	400
Pierce Oil Corp., Fort Worth	10,000	SD
Panhandle Ref. Co., Wichita Falls	4,500	2,200
Associated Pr. & Ref. Corp., Fort Worth	2,000	SD
Primrose Ref. Co., Wichita Falls	1,500	300
Interstate Refineries, Inc., Ranger	2,500	SD
Haggeman Ref. Co., Tiffin	2,000	300
Star Ref. Co., Fort Worth	1,500	300
State Ref. Co., Dallas	1,000	200
Sunshine State Ref. Co., Wichita Falls	2,500	1,400
Tidal Western Ref. Co., Burkburnett	3,000	2,600
Texas Company, Dallas	15,000	7,500
Texas Products Co., Waxahachie	2,000	SD

(Courtesy of Conley Tank Car Company)

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REFINERY AND GASOLINE PLANT ACTIVITIES

Bureau Urges Assistance in Compiling Monthly Reports of Refinery Statistics

Los Angeles, Calif.—W. C. Hill, petroleum economist of the United States Bureau of Mines, spent most of September in California, visiting refiners and urging upon them the importance of reporting their statistics earlier in the month to the Bureau, thus assisting him in releasing monthly reports much earlier than it has been possible in the past.

Mr. Hill left Washington August 19 and called on refiners at Chicago, St. Louis, Kansas City and Denver. He left California early in October to spend at least a week at Tulsa for the Petroleum Congress and before returning to Washington will tour the refinery centers of Oklahoma, Kansas, Louisiana and Texas.

Discussing the gathering of statistics earlier each month, Mr. Hill said:

"If the refineries would furnish the Bureau of Mines reports by the fifth of the month, our Bureau would be in a position to release the national statistics from Washington within three days after reports are received. In other words, the Bureau of Mines is now so efficiently equipped that its compilation of these figures is a mere matter of detail, requiring but a few hours work.

"In fact, if the California refineries, for example, were to deliver their reports to the San Francisco office of the bureau by the fifth of any month, the San Francisco office could return a report for the state of California by the next day.

"At the present time the various refineries of California are reporting their figures throughout the month over a period extending from the first to the twentieth or twenty-fifth. If companies now reporting as late as the twenty-fifth could manage to get in their reports say five or 10 days earlier, it would be a very material matter.

"It is noticeable that most of the major refining companies of the state get in their reports by the fifteenth of the month, but many of the smaller companies are rather dilatory. It seems a shame that this valuable report, having such a vital significance on the conduct of the country's business should be delayed 10 or 15 days on account of several of the smaller companies not reporting earlier.

"The bureau is very much disposed to do everything within its power to speed up these statistics. It has recently engaged a specially qualified representative to take charge of the statistical work of the San Francisco office, and I have been assigned to make a tour of the country for the specific purpose of improving and speeding up our statistical service. After canvassing the situation, I am satisfied that the bureau is now doing all within its power to give the industry the maximum efficiency of service, and it remains now for the refineries of the state to give their equal support in furnishing earlier reports."

Magnolia's Carbon Black Plant Put in Operation

Breckenridge, Texas.—The first unit of the carbon black plant being erected by the Magnolia Petroleum Company on the Jesse R. Smith farm, section 21, L. A. L. survey, Stephens County was placed in operation early in October, and construction work on the balance of the plant is nearing completion, with a potential capacity of 80,000,000 cubic feet of gas daily. When completed the plant will represent an investment of approximately 250,000, and will have a total of 60 burning houses, of which 10 are already in use. This plant is expected to realize a recovery of about one pound of black per 1,000 cubic feet of gas burned. The carbon black manufacturing branch is attached to the gasoline department of the Magnolia Petroleum Company, and J. R. Beacom is plant superintendent.

Kansas City, Mo.—The case of the Western Petroleum Refiners Association against the Missouri Pacific railway which seeks lower rates on fuel oil moving from the Mid-Continent field to eastern territory in order to compete with coal has been assigned for hearing by the Interstate Commerce Commission for October 31 here.

Plant and Location—	Capacity	Now Running
Texhoma Oil & Ref. Co., Wichita Falls	4,500	3,500
Tiger O. & Ref. Co., Breckenridge	1,500	200
Transcontinental O. Co., Ft. Worth	5,000	1,200
Travis Ref. Co., Burkburnett	1,000	200
Great Texas Ref. Co., De Leon	700	100
Uniform Pet. Co., Burkburnett	4,000	SD
Virginia Ref. Co., Dublin	4,000	SD
Victor Ref. Co., Burkburnett	2.000	SD
Wagoner Ref. Co., Electra	2,000	2,200
Walker Consolidated Ref. Co., Iowa Park	2,500	SD
White Eagle Oil & Ref. Co., Fort Worth	5,000	2,400
Waco Ref. Co., Waco	5,000	SD
Wortham Ref. Co., Wortham	400	SD
World Ref. Co., Bridgeport	800	SD
Texas total	178,600	59,000

*Being dismantled. †Rerunning. §Under construction.

OUTPUT OF REFINERIES DURING JUNE, 1923

	East Coast (N. Y., Phila. and Balto.)	Pennsylvania N. Y., E. Ohio and W. Va.	Ind. and Ill. W. Ohio, Ky. and Tenn.	Oklahoma and Kansas	Texas
Oils Run to Stills: (Barrels)					
Domestic Crude	7,693,330	1,861,932	4,556,090	6,140,170	7,372,734
Foreign Crude	1,578,851	.....	.....	.....	1,118,808
Total Crude Oils	9,272,181	1,861,932	4,556,090	6,140,170	8,491,542
Dom. Partly Refined†	353,163	1,100	.....	.....	.....
Foreign Partly Refined	292,726	.....	.....	.....	37,326
Casinghead Gasoline	8,205	9,097	28,863	112,962	106,900
Total Other Oils†	654,094	10,197	28,863	112,962	144,226
Total Oils Run†	9,926,275	1,872,129	4,584,953	6,253,132	8,635,768
Output of Refineries:					
Gasoline (gal.)	108,083,037	26,723,292	83,882,195	112,402,234	102,197,036
Kerosene (gal.)	37,279,327	13,047,041	17,520,062	20,140,887	42,732,155
Gas and Fuel Oils (gal.)	192,190,403	17,943,467	63,049,175	109,203,825	158,555,458
Lubricants (gal.)	24,266,361	14,322,321	8,224,598	7,375,119	28,887,064
Wax (Lb.)	14,702,438	5,451,124	2,873,613	2,724,256	4,252,459
Coke (ton)	13,323	1,717	15,986	2,032	7,906
Asphalt (ton)	91,867	426	11,788	5	38,866
Other Fin. Prod. (gal.)	9,754,297	1,365,583	5,984,935	2,134,524	4,039
Losses (Bbl.)	454,247	91,500	148,096	228,493	360,197
Domestic Partly Refined Products‡ (gal.)	.....	.....	629,898	786,556	4,112,038

Oils Run to Stills: (Barrels)	Louisiana and Arkansas	Colorado and Wyoming	California	Total	Daily Average, June 1923	Daily Average, June 1922
Domestic Crude	2,528,280	2,406,129	12,048,433	44,607,098	1,486,903	*
Foreign Crude	498,630	.....	.....	3,196,289	106,543	*
Total Crude Oils	3,026,910	2,406,129	12,048,433	47,803,387	1,593,446	1,393,488
Dom. Partly Refined†	.....	435,078	.....	.....	.....	*
Foreign Partly Refined	232,766	.....	.....	562,818	18,761	*
Casinghead Gasoline	24,976	37,707	81,241	409,951	13,665	*
Total Other Oils†	257,742	472,785	81,241	972,769	32,426	153,721
Total Oils Run†	3,284,652	2,878,914	12,129,674	48,776,156	1,625,872	1,547,209
Output of Refineries—						
Gasoline (gal.)	33,039,158	55,090,546	115,316,719	636,734,217	21,224,474	17,531,353
Kerosene (gal.)	16,015,057	14,340,954	17,998,275	179,073,758	5,969,125	5,788,320
Gas and Fuel Oils (gal.)	58,273,099	44,311,548	327,342,898	970,869,873	32,362,329	30,101,886
Lubricants (gal.)	1,835,467	1,644,630	9,170,543	95,726,103	3,190,870	2,671,275
Wax (lb.)	3,942,310	3,481,909	.....	37,428,109	1,247,604	1,555,658
Coke (ton)	7,324	6,028	.....	54,316	1,811	1,775
Asphalt (ton)	29,028	792	41,957	214,729	7,158	6,260
Other Fin. Prod. (gal.)	3,452,497	374,495	5,306,671	28,377,041	945,901	*
Losses (Bbl.)	49,843	64,581	199,380	1,596,337	53,211	53,257
Domestic Partly Refined Products‡ (gal.)	13,839,454	.....	16,057,732	2,273,401	775,780	*

*Not available prior to 1923.
†Net run to stills.
‡Net production.

natural gasoline

grade "a"

GRAVITY.....Not below 72° Be.
Not above 78° Be.
E. P.....Not over 375° F.
RECOVERY.....Not less than 90%

grade "b"

GRAVITY.....Not below 76° Be.
Not above 82° Be.
E. P.....Not over 375° F.
RECOVERY.....Not less than 85%

grade "c"

GRAVITY.....Not below 80° Be.
Not above 88° Be.
E. P.....Not above 350° F.
RECOVERY.....Not less than 78%

grade "d"

GRAVITY.....Not below 88° Be.
Not above 92° Be.
E. P.....Not above 350° F.

THE demand for Natural Gasoline is very strong. Stocks have been reduced to the daily plant production.

All good winter motor gasoline should contain a certain percentage of Natural Gasoline. The experienced auto driver wants it because it makes his engine start promptly even in the coldest weather.

Let us protect your fall and winter's supply of Natural Gasoline. Our large daily production and car supply put us in a position to serve your needs promptly at all times.

C&S CORPORATION

grade "1"

GRAVITY.....Not below 58° Be.
Not above 62° Be.
E. P.....Not over 437° F.
RECOVERY.....Not less than 91%

grade "2"

GRAVITY.....Not below 58° Be.
Not above 62° Be.
E. P.....Not over 450° F.
RECOVERY.....Not less than 90%

grade "3"

GRAVITY.....Not below 64° Be.
Not above 66° Be.
E. P.....Not over 440° F.
RECOVERY.....Not less than 88%

grade "4"

GRAVITY.....Not under 66° Be.
Not over 70° Be.
E. P.....Not over 435° F.
RECOVERY.....Not less than 85%

CHESTNUT & SMITH CORPORATION

GENERAL OFFICES - CHESTNUT SMITH BLDG. - TULSA OKLA.

To Follow Nicholas' Suggestion Would Be To Ruin Gasoline Manufacturing Business

Tulsa, Okla.—A diametrically opposed position to that taken by L. V. Nicholas, president of the National Petroleum Marketers Association, is held by the Association of Natural Gasoline Manufacturers, according to a statement issued by D. E. Buchanan, president of the association, subsequent to Mr. Nicholas' verbal barrage aimed at forcing the purchasing companies of the Mid-Continent to cut the price of crude.

The statement in full follows:

It would appear that the statements of one L. V. Nicholas, to the effect that the price of crude oil is completely out of line, and in fact, twice as high as it should be, and his demand on the crude oil purchasing companies that the present price should be cut in two, are either wilfully or ignorantly made, and not founded on facts which are apparent to any one who cares to study the existing petroleum situation.

His demand is ridiculous, and his statements would be worthy of no consideration were it not for the effect they might have on the public which is probably not informed as to the present crude situation. It would seem that he either has in view the utter demoralization of the industry and an ultimate higher price for gasoline to the consuming public, or he has not investigated the producing situation in the Mid-Continent field. Had he made any investigation he would have discovered that out of 57,000 wells in Oklahoma producing a total of 520,000 barrels per day, or an average of 9.1 barrels per well per day, 41,000 of these wells are producing only 80,000 barrels or an average of 1.95 barrels per day. He would have found in Kansas 17,391 wells producing 72,870 barrels per day, an average of 4.19 barrels per well per day, of which 10,000 produce less than 2 barrels each per day. Had he gone a little further and taken in the entire Mid-Continent field, he would have found an additional 4,000 wells producing less than 2 barrels per day, or a total for the Mid-Continent field of 55,000 wells producing less than 2 barrels per day.

Lifting Costs Can't be Cut

Although Mr. Nicholas may not know it, it is a fact well known to the producers of crude petroleum and others versed in that branch of the industry, that the average lifting cost for wells of this character is approximately $1.50 per barrel, leaving a very small margin on the present prices. If Mid-Continent crude is reduced to 80 cents per barrel, undoubtedly a large majority of these small wells could not be operated; especially is this true of such wells as are operated by the smaller producing companies. These wells are old, the production is settled, and varies little from month to month, or year to year, and they really form the backbone of the crude oil supply. If these wells are once shut down they will practically all be lost, and the backbone of the crude oil supply will be broken.

If Mr. Nicholas had cared to make a cursory investigation he would have found that less than 3,000 wells are producing over 60 per cent of the total production in Kansas and Oklahoma today.

Most of this is flush production, and it is only a question of time until these wells will settle down to the same basis as the 55,000 making less than 2 barrels per day. Consequently it will readily be seen that the small producing well is the one to be relied on, and must, therefore, be protected.

Can't Forecast 1924 Prices

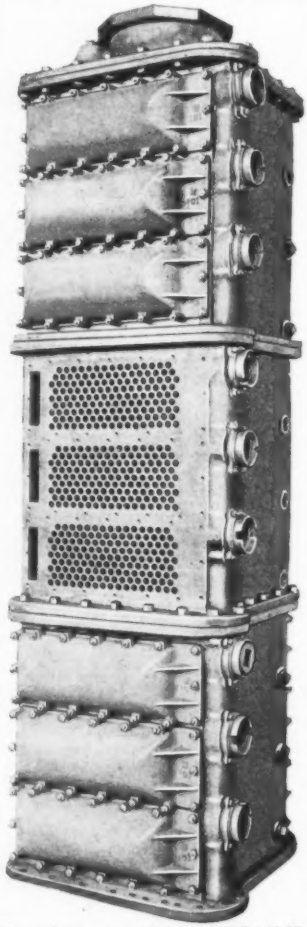
No one can prophesy the crude oil supply for 1924. The present wave of flush production is apparently near its zenith, and 1924 may find as great a famine in the supply of crude oil as the surplus of 1923. If the old settled producing wells are ruined, and the flush production exhausted with an ever increasing demand for gasoline where will it come from?

To follow out Mr. Nicholas' mandate would no doubt result in cheaper gasoline for the time being, but it might mean much higher gasoline forever after. If he is informed as to the exact situation, we challenge his sincerity and his desire for lower priced gasoline for the public he claims to be serving, and if he is not informed, we challenge his right to make even a recommendation.

While the Association of Natural Gasoline Manufacturers is a part of the

Type B-540
Gasoline Condenser
(Patented)

Compact — Efficient — Flexible



Dimensions — overall, 30" x 30" x 9'-0"
(inc. top and bottom bonnets)

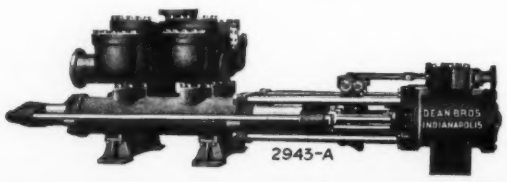
SOUTHWESTERN CONDENSER COMPANY
1215-1221 Hollingsworth Bldg.,
Los Angeles, Calif.

DEAN BROS. CO.
INDIANAPOLIS.

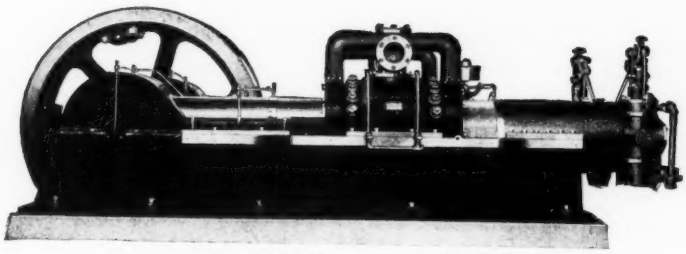
OIL PUMPS
For Hard Continuous Service

The pumps will not short stroke. Are substantially and carefully built. Have large and free passages which do not restrict the flow. Extremely economical in the use of steam.

Send for Catalogue.



THE NEW ENCLOSED TYPE



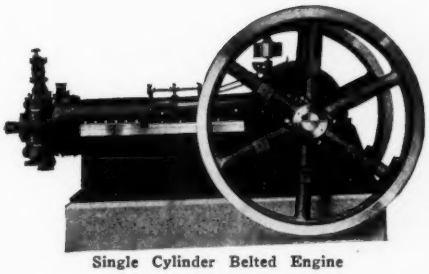
Direct Gas Engine Driven Vacuum Pump, Two Cylinder

Watts-Miller Gas Engines and Direct Gas Engine Driven Compressors and Vacuum Pumps

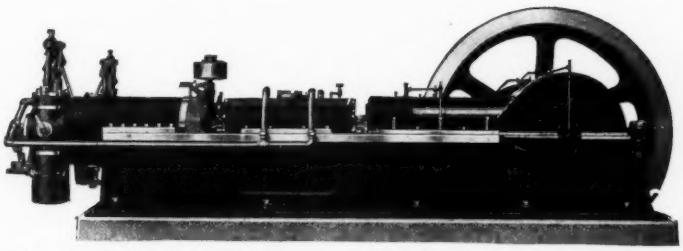
Pat. June 22, 1897; Oct. 6, 1914; April 13, 1915

High Efficiency Gas Engines, Compressors, and Vacuum Pumps for Power Plant Equipment

Sizes from 50 to 400 h. p.



Single Cylinder Belted Engine



Direct Gas Engine Driven Compressor, Two Cylinder, Single or Two Stage

Compressors particularly adapted to casing-head gasoline plants, gas pumping plants, and compressed air installations, in single and 2-stage machines to operate on practically all intake and discharge pressures. Continuous circulating filtering automatic oiling system.

The Miller Improved Gas Engine Co.

SPRINGFIE D, OHIO

DISTRIBUTORS

BRANCH SALES OFFICE
323 North Cheyenne Ave.,
Tulsa, Okla.

FRICK-REID SUPPLY CO.
Casper,
Wyoming.

Service Department and Warehouse, 323 North Cheyenne Ave., Tulsa.

Tell them where you saw the ad

whole petroleum structure, and is vitally interested in the welfare of every branch of the industry, it is for the manufacturers of natural gasoline that we hold a brief. The effect upon the natural gasoline industry of shutting down even temporarily a large majority of the 55,000 small wells above mentioned, can hardly be estimated. It is from a large number of these small wells that the richest casinghead gas is obtained, and the gas will be lost as soon as the wells are closed down. This will have the effect of causing hundreds of gasoline plants to shut down and would spell ruin to many natural gasoline manufacturers. It would also defeat the principle of conservation which prompted the utilization of gas for the recovery of gasoline and deplete the gasoline supply to the consuming public. This could only result in higher gasoline prices to the consumer.

From every angle Mr. Nicholas' demands seem to be economically unsound, not alone on account of the prospect of such action causing higher prices in the future, but because of the tremendous momentary loss that would be suffered by hundred of thousands of stockholders who have financial interests in the companies which would be ruined.

STOCKS AT REFINERIES IN THE UNITED STATES JUNE 30, 1923

	East Coast (N. Y., Phila. and Balto.)	Pennsylvania N. Y., E. Ohio and W. Va.	Ind. and Ill. W. Ohio, Ky. and Tenn.	Oklahoma and Kansas	Texas
Crude Oil and Partly Refined Products: (Barrels)					
Domestic Crude	5,003,913	1,231,295	1,263,303	4,946,779	4,715,649
Foreign Crude	2,843,936	.....	.....	.....	1,238,885
Total Crude Oils	7,847,849	1,231,295	1,263,303	4,946,779	5,954,534
Dom. Partly Refined	4,577,771	858,131	2,313,262	2,236,370	5,884,894
Foreign Partly Refined	46,113	.....	.....	.....	23,755
Total Other Oils	4,623,884	858,131	2,313,262	2,236,370	5,908,649
Total Oils to be Run	12,471,733	2,089,426	3,576,565	7,183,149	11,863,183
Finished Products:					
Gasoline (gal.)	247,529,730	29,451,088	171,542,719	261,850,029	155,277,673
Kerosene (gal.)	69,849,564	19,148,686	38,010,732	26,746,621	53,160,443
Gas and Fuel Oils (gal.)	271,218,099	30,526,512	38,303,567	102,563,879	301,333,605
Lubricants (gal.)	82,816,058	33,196,803	21,767,749	14,128,227	52,326,310
Wax (lb.)	41,884,841	18,586,002	30,112,913	5,950,726	9,490,613
Coke (ton)	7,614	265	5,910	1,891	4,359
Asphalt (ton)	73,465	2,192	9,519	188	23,684
All other Fin. Prod. (gal.)	6,400,349	982,726	17,976,590	5,484,588	139,602

*Data not available prior to 1923.

Crude Oil and Partly Refined Products: (Barrels)	Louisiana and Arkansas	Colorado and Wyoming	California	Total Stocks June 30 1923	1922
Domestic Crude	4,406,289	972,379	2,843,912	25,383,519	*
Foreign Crude	2,251,903	.....	.....	6,334,724	*
Total Crude Oil	6,658,192	972,379	2,843,912	31,718,243	36,178,308
Dom. Partly Refined	2,352,365	2,018,810	8,559,205	28,800,808	*
Foreign Partly Refined	225,392	.....	.....	295,260	*
Total Other Oils	2,577,757	2,018,810	8,559,205	29,096,068	867,914
Total Oils to be Run	9,235,949	2,991,189	11,403,117	60,814,311	37,046,222
Finished Products:					
Gasoline (gal.)	95,838,419	159,233,578	142,859,892	1,263,583,128	824,966,456
Kerosene (gal.)	27,891,899	28,574,223	20,918,844	264,301,002	317,574,464
Gas and Fuel Oils (gal.)	111,237,322	34,048,671	434,793,452	1,324,025,107	1,326,939,662
Lubricants (gal.)	3,181,644	5,245,046	12,475,393	225,137,230	226,903,812
Wax (lb.)	69,574,029	3,004,664	189,321	178,793,109	232,135,228
Coke (ton)	.....	4,299	.....	24,338	78,312
Asphalt (ton)	11,439	706	17,307	138,500	154,680
All other Fin. Prod. (gal.)	973,811	348,880	424,775	332,731,321	*

Would like to contract with some refinery for about 125 tank cars of gasoline yearly. Direct reply care The REFINER, Box 37.

Electrically Driven Centrifuges
Hand Centrifuges
WRITE
WILLIAMS, BROWN & EARLE, Inc.
Manufacturers of Laboratory Apparatus
918 Chestnut St. Philadelphia, Pa.

Ponca City, Okla.—Marland Oil Company is completing storage amounting to six 80,000 barrel tanks at the company's export terminals recently acquired at Texas City, Texas.

New Concern to Build Big California Plant

Los Angeles, Calif.—Western Refining Company is being financed here to erect refinery at Wilmington Harbor to have ultimate capacity of 60,000 barrels of crude a day. Plans call for a pipe line to Signal Hill and it is understood that products will be marketed in foreign countries. The company has 100 acres of land and will have terminal facilities at the harbor. Richard Florian is president and general manager, and R. R. Rakestraw is vice president. Both officials were connected at one time with the Standard Oil Company of California.

Cross Refining Company Is New Texas Refiner

Corsicana, Texas.—The Cross Refining Company has been selected as the name of the new refinery being erected a short distance south of Corsicana on the H. & T. C. railroad at Angus station by Edward E. Stewart of Burkburnett, H. H. Cross & Co., marketers and jobbers of Chicago, and T. A. Edmonds of Fort Worth. Construction work was started last August, and original plans were to have a daily capacity of 1500 barrels; but another still has been added, giving it a capacity of 2000 barrels when completed. It is planned to have the plant in operation within the next 60 days, and it will operate on crude from both the Currie and Corsicana-Powell fields.

Neodesha, Kans.—Because the company's stocks of gasoline on hand are sufficient for current business, crude oil runs to stills at the refinery here of the Standard Oil Company (Kansas) have been temporarily discontinued. The plant is running gas oil.

PIONEER TANK & BOILER COMPANY
TULSA BOILER & SHEET IRON WORKS
A New Name for an Old Friend
WHAT'S in a name, anyway? The refinery construction work we are doing under the name "Pioneer" is just the same high grade as when it bore the name "Tulsa Boiler and Sheet Iron."
For eighteen years, as the "Tulsa Boiler and Sheet Iron Works" we have turned out tanks and refinery steel construction that made good friends for us among the wise buyers of the Mid-Continent. We pioneered in giving these people "close to home" service on the best kind of work.
Now, under the new name, The Pioneer Tank and Boiler Company, we're all set with the men, machinery and money to keep on growing under the Pioneer banner like we did when Tulsa Boiler and Sheet Iron was on our letterhead.
There is no change in our organization.
Get Pioneer quotations on tank and refinery construction work.
PIONEER TANK & BOILER COMPANY
(Formerly Tulsa Boiler and Sheet Iron Works)
Box 1926, TULSA, OKLA.

Company Looking for Site To Build Plant in New Mex.

Santa Fe, N. M.—The Navajo Refining Company which recently took over the Polar Producing and Refining Company's plant at Sapulpa, Oklahoma, is understood to be negotiating for a site in the San Juan Basin country in New Mexico. The company is said to be backed by Oklahoma oil men.

Chicago, Ill.—Approximately 100 representatives of the industrial relations department of the Standard Oil Company (Indiana), including pumpers, stillmen and other workers in the company's refineries over the country, in company with executives of Standard Oil, attended the fifth annual conference held in Chicago September 17. The plan was inaugurated by Col. R. W. Stewart, chairman of the board of the company.

Boston, Mass.—Refinery of New England Oil Refining Company at Fall River is running about 750,000 barrels of crude a month, of which 500,000 is California oil and the remainder other oils, principally Mexican. Operations are being conducted at a profit.

Three Associations Will Have Combined Headquarters

Tulsa, Okla.—Offices of the Western Petroleum Refiners Association, Association of Natural Gasoline Manufacturers and the Mid-Continent Oil and Gas Association now are located on the fifth floor of the Cosden building here.

Tulsa, Okla.—Cosden and Company is rushing work on its natural gasoline plant being built on the Morris road outside of Okmulgee, Oklahoma. The plant will cost around $225,000.

Augusta, Kans.—Grant Oil Company has filed suit in district court in Butler County, Kansas, against Lakeside Refining Company for recovery of $250,000 alleged to be due on payments for crude oil supplied by the Grant company to the refining concern.

Start Work on New 500 Barrel Plant in Texas

Tahoka, Texas.—Construction work has been completed on the 500 barrel daily capacity skimming plant located near here by the Tahoka Oil Refining Company. The plant is to operate on crude shipped in by tank cars from the Moran and Pioneer fields in Central West Texas, while the refined products are to be sold locally and to other West Texas towns. A. T. Keith is manager of the company.

Wichita, Kans.—So as to be in a position to carry out its recent announcement of storing crude to the account of producers with whom the company's lines are connected, the Derby Oil and Refining Company has purchased a farm 25 miles east of Wichita in the Augusta district of Butler County and is starting construction on the first 55,000 barrel tank of a series it contemplates erecting.

LUCEY

"Wherever LUCEY There's Oil"

STEEL CASTINGS FOR REFINERIES

Open Hearth Process
Quick Delivery—Made in Houston
From One Pound to 8000 Pounds
Analysis of Every Heat Controlled in Our Own Laboratories, Insuring Uniform Quality.
Complete Pattern Shop, Machine Shops, Metallurgical and Engineering Staff at Your Disposal.

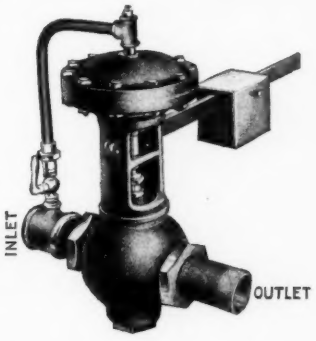
R. U. CULBERSON, Receiver
LUCEY MANUFACTURING CORPORATION OF TEXAS
Houston, Texas

Beaumont, Texas Shreveport, La. El Dorado, Ark. Mexia, Texas
Smackover, Ark. Corsicana, Texas Dallas, Texas

STEEL

A Safeguard for Your Gas Lines

Fulton Pressure Regulator

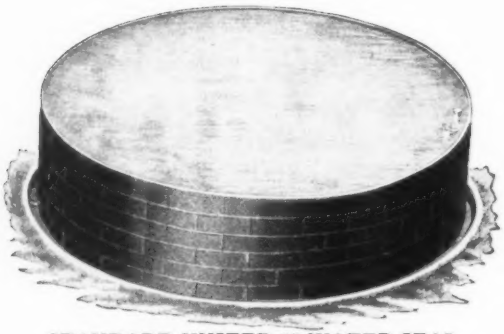


Set the Fulton Back or Check Pressure Regulator at the desired pressure, and it automatically guards against the gas pressure rising above or falling below this predetermined point. Maintains given pressure at gas wells. So made that friction is reduced and a quick response to the slightest change of pressure is insured.

Write us for folder giving full information and prices

THE CHAPLIN-FULTON MFG. CO.
30 Penn Avenue Pittsburgh, Pa.

"UNITED"
WATER SEAL TANKS



STANDARD UNITED 55 WATER-SEAL

PREVENTS EVAPORATION

The construction of "United" Water Seal Top Tanks is similar to other steel tanks, except that they have a flat roof constructed of steel plate, tight riveted and caulked water tight. The roof is located about seven inches below the top of last ring of tank shell, and is carried on steel framing properly designed to carry the load intended. The space between the top of tank ring and roof is then filled with water which can be kept constantly circulating, thus keeping the tank and its contents cool. **Not only is the escape of rising vapors entirely eliminated, but your FIRE HAZARD is also reduced to a minimum.**

FREE Let us send you Special Bulletin on "United" Water Top Tanks. It's free and contains much valuable information.

SEND US INQUIRIES FOR

Storage Tanks	Pipe Line Supplies
Complete Refineries	Pumping Equipment
Agitators	Special Castings
Loading Racks	Refrigerating Machinery
Stills	Furnace Fittings
Towers	Cooler Boxes
Condenser Boxes	Tail House Look Box
Special Forgings	Cross Cracking Plants
Fittings of All Kinds	Etc., etc., etc.

Get "United" Prices before buying. Quotations promptly made without obligation.

United Iron Works, Inc.
KANSAS CITY, MO.

TULSA **DALLAS**

Cracking—Or Making Your Oil Pay Dividends

(Continued on page 36)

The Isom system, U. S. Patent 1,285,200 as adopted by the Sinclair Refining Company operates at 100 to 125 pounds pressure and at temperatures rarely exceeding 750 degrees F.

The Isom stills have charging capacity of 235 barrels of raw gas oil and operates at a rating of approximately 1200 barrels per day. The heating elements consist of fifty 4 inch tubes fitted with Foster superheater rings containing 2700 square feet of heating surface while the oil is heated over 900 square feet of tube surface. The oil is circulated through these heating elements which are arranged vertically in the furnace by means of a Connersville 14 x 28 two lobe hot oil pump to and from a 9-foot diameter by 32 foot long horizontal still. The vapors released in this still are conveyed through a 60-inch diameter by 28 feet high reflux tower. The system is charged continuously during the cycle by pumping the raw oil over the top of the tower. Vapors are condensed under pressure and the regulating valves for the continuous draw off as well as for the condensates are located in the receiving house.

The still are operated on a 48-hour cycle; 30 hours of continuous running and 18 hours for starting up, cooling down and cleaning. Depending upon the rate of charge and how hard the heaters are fired the following results are obtained: 500 to 800 barrels of 49.8 Be. gravity distillate received overhead and 500 to 800 barrels of 24.0 Be. gravity pressure tar drawn off per run of 30 hours.

Under normal operating conditions, 50 per cent of the continuous charged gas oil comes over a distillate, 45 per cent of the continuous charged gas oil drawn off as tar, and 7 per cent of the continuous charged gas oil is loss and carbon.

New York, N. Y.—For the first seven months of 1923 reports of the marketing division of the Cities Service Company reflect an increase in the consumption of petroleum products. In the Northwest a 25 per cent increase is expected; in the Middle West a 100 per cent increase is indicated, while in the Southwest a 10 per cent increase is looked for. In the Eastern section an increase of 150 per cent is anticipated.

Dallas, Texas.—Officials of Panhandle Refining Company in letter to stockholders comment on refining situation as follows: "The price of gasoline is so low that it is impossible to refine oil at a profit at the present price of crude oil. Recent cut in posted price has had effect of reducing the loss, but it is not low enough yet to make refining profitable."

Tulsa, Okla.—The Western Gas and Power Company, which recently installed a gasoline plant near Sayre, Oklahoma, has opened offices in the Fidelity National Bank building here.

Wichita, Kans.—E. M. Luther of Cimarron, Kansas, has been appointed receiver for the Kansas Gas and Petroleum Company and its subsidiaries, the Frontier Refining Company and the Penn-Western Lubricating Company.

Based on actual performance, a double Dubbs unit running on Long Beach California Residue 18-19 gravity direct to the process without pre-treatment and only once through will crack over 2000 barrels of this stock per day and each day's run will yield more than 550 barrels of good new Navy IBP-EP gasoline

The remainder is a fuel oil, zero cold test and very low viscosity; a better fuel oil with more BTU's per gallon and more easily handled than the original charging stock and this after you have taken out more than 550 barrels of good gasoline

We leave it to you to figure the profit

The Dubbs Process can do with your Residue what it is doing with Long Beach Residue

Universal Oil Products Company
Owners of the Dubbs Process
208 South La Salle Street Chicago

÷ REFINERY SUPPLIES ÷

Refiners' Supplies

	Oct. 10
Soda Ash light 58% ..... cwt.	$1.75–2.10
Silicate of Soda 60 deg. bbls..... cwt.	–2.00
Sal Soda wks ..... cwt.	1.10–1.30
Caustic Soda 76% ..... cwt.	3.10–3.30
Chloride of Lime solid ..... cwt.	1.35–1.70
Sulphuric Acid 60 deg. tank cars f. o. b. shipping point ...per ton	9.00–11.00

*Benzol—

	Oct. 10
Pure Water White .....Tanks....gal	—.27
Drums...gal.	—.32
90% .....Tanks....gal.	—.25
Drums...gal.	—.30

Jobbers' Supplies

Vegetable Oils—

*Linseed, carloads Spot .....gal.	.91–
October .....gal.	.90–
Nov.-Dec. .....gal.	–.89
Less carload Spot .....gal.	–.94
5 bbls. or less Spot .....gal.	.95–.98
Boiled, tank Spot .....gal.	–.87
Boiled, carloads Spot .....gal.	–.93
Soya Bean Spot, Tanks .....lb.	.09¼–.09½

Animal Oils—

English Degras .....lb.	$–.04⅜
Domestic Degras, bbls., carloads ...lb.	–.04
Horse .....lb.	–.08

Oleic Acids—

Dist .....lb.	–.09¾
Saponified .....lb.	–.09¾

Lard Oils—

Prime	
Winter	
Strained .. 1 to 1½ ffa. 40/45c. t. lb	$.16
Extra	
Winter	
Strained . 2 to 4½ ffa. 40/45c. t. lb.	.13¾
Extra .....4 to 5 ffa. 40/45c. t. lb.	.13¾
Extra No. 1 ...7 to 10 ffa. 40/50c. t. lb.	.12
No. 1 .....15 to 18 ffa. 40/45c. t. lb.	.11½
No. 2 .....22 to 23 ffa. 40/45c. t. lb.	.11
Prime Edible Tallow under 1% ffa. 40/45c. t. N. Y. .....lb.	–.09½
Tallow acidless .....lb.	.12¼
Lard Stearine .....lb.	.15¾
Oleo Stearine .....lb.	.13

Neatsfoot Oil—

Pure .....bbls.-lb.	.14¼
Extra .....bbls.-lb.	.11½
No. 1 .....bbls.-lb.	.11
Cold pressed .....lb.	.17¼

Fish Oils—

Menhaden Oil	
Light pressed .....gal.	$ –.65
White .....gal.	.68–.70
Yellow bleached .....gal.	–.67
*Herring, tankcars coast .....gal.	–.40
Whale, extra winter bleached ....gal.	–.81
Seal	Nominal

Naval Stores—

Turpentine, N. Y. .....gal.	1.00
Turpentine† .....gal.	.92½
Rosin B. N. Y. .....Bbl.	5.95
Rosin F. N. Y. .....Bbl.	5.95
Rosin B.† .....Bbl.	4.50
Rosin F.† .....Bbl.	4.50
Rosin Oil 1st run .....gal.	.42
Rosin Oil 2nd run .....gal.	.48

Pine Tar—

Kiln Burnt .....Bbl.	11.00
Retort .....Bbl.	11.00

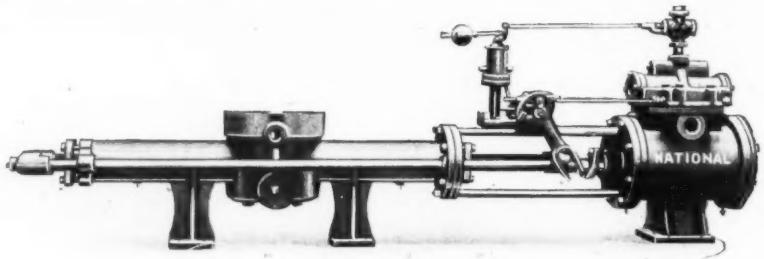
*Nominal
†Savannah, Ga., market.

Island Plant Taken Over By New Haskell Company

New York, N. Y.—The newly formed Gulf States Oil and Refining Company, subsidiary of Middle States Oil Corporation, has acquired the plant of the Island Refinery Company near New Orleans, together with the stock of the company owning a refinery at Palo Blanco and a $12,000,000 claim against the Island Oil and Transport Corporation and its subsidiaries. The deal has been agreed upon by stockholders' protective committee of the Island Oil and Transport.

Cleveland, Ohio.—The National Motorist Association has extended invitations to all automobile clubs in the United States to attend a conference here latter part of September to plan action for a complete survey of the gasoline situation.

Special High Pressure Oil Pump



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"ALL NATIONAL" Pumps are equipped with Balanced Piston Valve Chests. This construction meets the demand where efficiency-endurance and absolute reliability at all times are essential. All pumps have heavy construction and large valve area, making them ideal for refinery pumps.

Our regular line includes:
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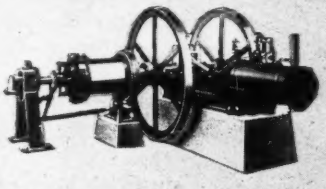
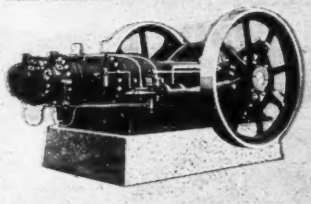
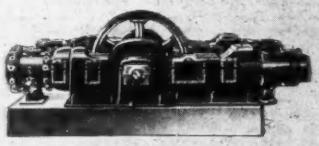


The Bessemer Oil Field Engine
Famous in oil territory the world over. The original two cycle engine with cross-head construction.

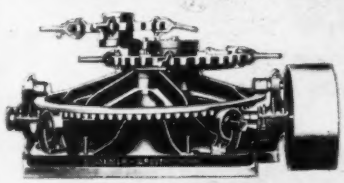


Bessemer Type IV Oil Engine
A dependable engine of trouble-free performance, which operates on inexpensive fuel oil.



The Bessemer Type Ten Compressor
This is the newest Bessemer unit, combining engine and compressor in one unit and incorporating numerous refinements.

The Bessemer Type VIII B Direct Driven Compressor
Standard equipment in the Gasoline-from-Gas Industry. The most efficient and economical means of gas or air compression.



Bessemer Roller Pumping Power
A compact pumping unit which keeps rods close to ground. Master wheel kept level by six rollers.

A synonym for the Best for a Quarter Century

From the first gas engine in 1898 to the Type Ten compressor in 1923, Bessemer leadership in the Oil Field has been an undisputed fact.

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While all pigments possess properties that are recognized as desirable, many of them have characteristics which make them unsuitable for use under certain conditions of application and exposure. The use of any pigment or a combination of pigments should be determined by a knowledge of the requirements to be met and experience in meeting them.

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